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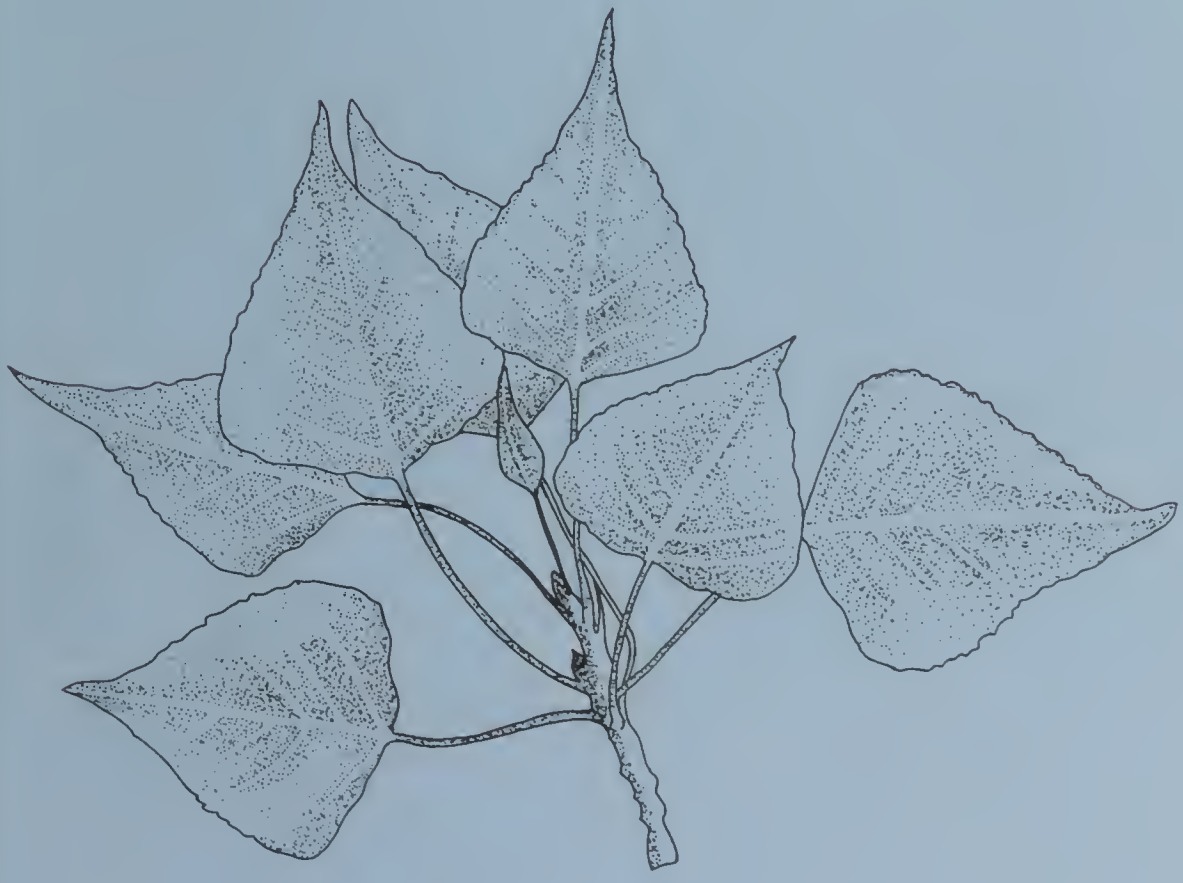

TRANSACTIONS OF THE NORFOLK AND NORWICH NATURALISTS' SOCIETY

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FRONT COVER: Leaves of Black Poplar *Populus nigra* ssp. *betulifolia* (see p. 375)
P.W. Lambley

THE CHANGING STATUS OF INSECTS IN NORFOLK

THE PRESIDENTIAL ADDRESS DELIVERED TO THE SOCIETY ON 3 FEBRUARY 1993

A. G. Irwin

Castle Museum, Norwich NR1 3JU

Ladies and Gentlemen -

The honour of being elected President of this Society must always be tempered with the knowledge that sooner or later an Address should be delivered. In contemplating this prospect, I expect I was not the only President to think of a title before knowing exactly what I was going to say! So I gave our programme secretary a suitably broad title - the Changing Status of Insects in Norfolk - in the hope that when the time came, I would be able to think of some way of fulfilling the expectations of the audience. How I have regretted that title! Why couldn't I have suggested "the Changing Status of Earwigs in Norfolk" or "the Changing Status of Flies in my Front Room over the last ten years"?

In my journey through the literature, almost everywhere I encountered evidence of the changing status of insects in Norfolk. So much so that it was refreshing to find examples of species which had not changed! My problem was to choose from so many examples those which best illustrate the processes that bring about changes in our fauna.

The status of an insect encompasses several elements. Firstly does it, or does it not occur in the county? If it occurs in the county, does it breed here, or is it just an occasional visitor, perhaps from overseas? If it does breed here, does it do so regularly, so that resident populations can be identified? Are those populations widespread, or are they localised? Are the populations large, or are they small? How long have those populations been established, and how much longer will they survive?

Of all these elements, only the last is a matter of opinion. All the others are matters of fact. Yet the status of an insect can change dramatically even though it's living now just as it has for the last ten thousand years. How? - It can be discovered! One moment a tiny beetle is pushing its way through a sticky patch of North Norfolk shingle, the next it is sieved, spotted, tubed, dispatched, carded, identified and published - "*Bibloplectus minutissimus* new to East Anglia" (Irwin,1983). Such a short step from oblivion to fame! As much as anything, recorded status is perceived status. Indeed our perception of an insect's abundance is primarily a reflection of how readily it comes to our attention. Plagues of locusts, fleas, wasps, hoverflies, ladybirds or aphids have always hit the headlines. How many of you remember the lupin aphid? Were it not for the spectacular way it affected wild and cultivated lupins (Ellis, 1983), its arrival in this country might have passed unnoticed.

It would be foolhardy to document changes to the status of most small insects by comparing old accounts in the literature with what we know today. Most groups were little understood, and the available identification works were incomplete and unsatisfactory, if not misleading or downright wrong. There were exceptions, however. In 1829 a list of Norfolk beetles by Robert Wigham contained 75 species, of which 17 were in the family Pselaphidae. This is not an indication that Norfolk was particularly rich in these beetles, though it does have 33 of the 51 British species. Rather, it marks the friendship that Wigham had

with Henry Denny, who wrote the first monograph on this group just before Wigham's list was published (Denny, 1825). Most of Wigham's entries are simply annotated "Norfolk", so they are of little use in evaluating the past distribution of species within the county. This hardly matters in the case of the pselaphids, for at one to two millimetres long they are among the most easily overlooked of Norfolk beetles, and our present knowledge of their distribution is sketchy, at best.

It is with the more easily observed, and more easily recognised, insects that we can rely upon the observations of earlier naturalists and upon our own knowledge of the species, to judge whether a change in status has occurred. Butterflies, moths, crickets and dragonflies are more likely candidates for study. County surveys (Hall, 1991; Milford and Irwin, 1990; Richmond and Irwin, 1991) during the last ten years provide an excellent baseline from which to resurvey the county in the future, and also to look back forty, one hundred or even three hundred years ago.

Sir Thomas Browne was a Norwich doctor, who has provided us with a wonderful glimpse of seventeenth century Norfolk. In his notes (Browne, 1662) he mentions that "*the Gryllotalpa or fencricket comon in fenny places butt wee haue met with them also in dry places dunghills and church yards of this citty*". In 1834, the Paget brothers in their Natural History of Yarmouth note that the mole-cricket occurs at "*Caister; occasionally*". Thomas Southwell, commenting on Browne's letter in 1901, says "*the mole-cricket ... is rare with us*", while Edwards in the Victoria County History of 1901 suggests "*that grand insect ... will probably prove to be generally distributed if properly searched for*", but he only cites one locality - Stoke Holy Cross. In 1921, Henry Thouless recorded an 1862 specimen from Castleacre and notes that "*several specimens were brought to me some years ago from Shottesham Common.*" No later authenticated records are known from Norfolk, and the species is now regarded as extinct in this county. Nationally the mole-cricket was widespread and common until the extensive drainage and improvement of pasture in the 17th and 18th centuries, was local in the 19th century and vanished from most areas by 1950 (Marshall & Haes, 1988). It survives in a very few sites in Southern England.

Unfortunately this tale of a common insect becoming more local, less abundant and eventually extinct is not unusual. The large marsh grasshopper was found locally across Norfolk wherever its habitat of quaking bog occurred. In the early 19th century, the Pagets (1834) recorded it as common at Belton Bog, and Wigham (1829) noted it at Horning. Until 1939, it still occurred in the Broads, but recent searches there, and in West Norfolk at Wolferton where it was last seen in 1968, have proved unsuccessful (Richmond and Irwin, 1991). Elsewhere this grasshopper can still be found in most of its former haunts in South-west England and Western Ireland (Marshall & Haes, 1988). The species can survive in quite small areas, so evidently some change of character in the quaking bogs of East Anglia has rendered them unable to support it any longer.

Among the flies, only those species which are noticeable and easily recognised should be subject to this retrospective investigation. Outstanding among the British fauna is a yellow and black robber fly, *Asilus crabroniformis*, which was well known to the Pagets (1834), who note "*fields, Fritton; sometimes common*". In 1915 Morley and Atmore recorded it from Holme and "*scarce about King's Lynn*". It should be remembered that until the First World War, most fieldwork

was done close to one's home or close to railway stations. We take for granted the ease with which we can visit sites across the county, but for the young Ken Durrant, the car meant less time on his bike and more time recording. In 1960 he wrote "*Asilus crabroniformis ... used to be very common on all large heaths before the second world war, but is now found only rarely*". Indirectly, the advent of motorised vehicles sealed the fate of *Asilus*, for its larvae feed on the larvae of dung beetles. With fewer horses on the farm, and changes in the way that cattle are kept, the dung simply isn't there any more, and *Asilus* has vanished from the county.

Improvements in animal husbandry have almost led to the extinction of another fly. The sheep nostril fly is a parasitic species in which the adults cannot feed. Their role in life is to mate and lay their eggs in the nostrils of sheep. The maggots do all the feeding, in the mucous linings of the sheep's nasal cavity. When fully fed, they are sneezed out to pupate in the ground. At one time they must have done a great deal of damage to the large flocks of sheep that roamed Norfolk, but veterinary medicine has almost completely eradicated them. The only recent record is from the Stanford Practical Training Area (Foster, 1987a). Presumably compensation is the same whether your sheep has nostril fly or not. Nationally, the fly has recently been granted Red Data Book 3 status (Shirt, 1987) - only one category lower than the swallowtail, but I doubt that it will ever enjoy legal protection.

It is interesting to note that the swallowtail seems to have changed little in status during the last hundred years. Nationally, it has disappeared from Cambridgeshire, but in Norfolk it occupies the same areas in much the same numbers as it has for a long time (Heath *et al*, 1984). In 1874 Barrett wrote "*found in all the fens of the rivers Yare and Bure and their tributaries ... Its range in this country is gradually becoming more restricted, from the drainage of the fens of Cambridge and Huntingdonshire, and it seems probable that in a few years, it may have ceased to be found in any numbers elsewhere than in our Norfolk fens. Here, however from the nature and extent of our fens, and their situation along the river courses, and from the strictness with which many of them are preserved, there is reason to hope, that this splendid species may survive till a very distant period.*" If this is "*a very distant period*", then Barrett's hope is fulfilled, although it is probably less common in the Yare Valley than it used to be. According to Ted Ellis (1984) this is due to "*increased incidence of tidal flooding*". Swallowtails are prone to population fluctuations, and this has led to talk of their decline in the past, but the Broadland population seems to be holding its own (Hall, 1991).

During the period 1740-1760, William Arderon was making notes and collecting specimens of butterflies and other insects around Norwich. He writes of the "*Swallow Tail*", and "*the White Butterfly with black veins*" (Arderon, 1740-60). This reference to the black-veined white butterfly is interesting because it soon became extinct in Norfolk, probably within the eighteenth century. The species is not mentioned by Wigham (1829) or by the Pagets (1834). Barrett's (1884) reference to it is "*doubtless long extinct*". In the nineteenth century, the species was widespread throughout much of South-east England, but a rapid decline from about 1850 soon resulted in its restriction to Kent, where the last specimen was seen in 1922 (Heath *et al*, 1984). The causes for the decline in this species are unknown, but it seems likely that its occurrence in Norfolk was a result of temporary expansion beyond its optimum range. Its extinction in this country was

merely a return to normal.

The expansion and contraction of butterfly ranges is well documented for a number of species. In this county, species which have recently expanded their range include the comma, which Barrett described as "*very rare in this county*" in 1874. It had disappeared from Southern and Eastern England by the turn of the century, and did not spread back again from its Western strongholds until the 1930's (Heath *et al*, 1984). Now the comma is probably as common in Norfolk as it ever has been (Hall, 1991).

No mention of the white admiral occurs in the early literature, and the first record of this species in Norfolk dates from 1933 (Ellis, 1984). It became widely established in the county in woods where honeysuckle was available, but its centres of distribution are now in the Brecks, the woods north of Norwich, and around Upton (Hall, 1991).

Fluctuations in the size of butterfly populations may lead to expansions or contractions of range. In a good year, the numbers of dispersing individuals will be high and the chances of a successful establishment at a new site are better. In a poor year, newly formed populations, particularly where they are at their ecological or climatic limits, may not be able to produce enough offspring to ensure survival of the colony. A good example of this is the speckled wood butterfly, long regarded as uncommon in Norfolk. During the 1960's it built up strong populations in Breckland, and in 1986 a spectacular dispersal gave rise to sightings across the county (Hall, 1991). In the following years small outlying colonies had become established as a result, but whether they will survive for long remains to be seen.

Fluctuations may occur with a shorter time scale. The holly blue is perhaps the most obvious species to demonstrate this, frequently establishing colonies in gardens and parks, even in built-up areas, and at times being the most abundant urban butterfly. Then something happens, and the populations crash. Exactly what causes these crashes is not always clear. In the case of the holly blue, a build up of parasites has been implicated, though climate may also play an important role (Ellis, 1984; Heath *et al*, 1984).

The large tortoiseshell was well-known to 18th and 19th century entomologists, but it is a species that is known to be subject to massive fluctuations in abundance (Heath *et al*, 1984). It reached a peak in the 1940's and has been in decline ever since, the last authentic Norfolk specimen having been recorded in 1967 (Hall, 1991). This has been a national decline, from which the species may never recover, for it is an elm feeder. The decline of elm following Dutch elm disease, spread by the elm bark beetle, has certainly affected populations of it, and the other elm-feeding butterfly, the white-letter hairstreak (Heath *et al*, 1984; Hall, 1991). This species is not subject to the same population checks as the large tortoiseshell, but it is a local, sedentary species and where a population disappears, it may be a very long time before a stray female is able to start a new one.

Where long-term changes occur, climate may be to blame, but more often a simpler explanation lies with changes in habitat. Needless to say, these changes are almost always of human origin. The most renowned case of change in status of any East Anglian insect is the decline and eventual extinction of the British race of the large copper butterfly. Apparently a change in the traditional management of the fens led to a decline in the population, a trend which may have been

exacerbated by a local trade to keep collectors supplied in the 1820's (Heath *et al*, 1984). Not long afterwards, the fens where the species occurred were drained, so the butterfly was doomed in any case. The few records from the Norfolk Broads indicate that the populations there were probably small, and possibly established only for a short time (Irwin, 1984).

Changes in the management of pasture have already been mentioned as a reason for the decline of the mole cricket. The marbled white butterfly is another species which may have disappeared from Norfolk for similar reasons. The species was known to Arderon (1740-60) who collected it in the neighbourhood of Norwich in the mid 18th century. Wigham (1829) also records it from "Norfolk", and Barrett (1901) refers to Crowfoot's records from Kirby Cane, where "*it moved from one spot to another almost every season*". Crowfoot's observation is not unusual, as more recent studies testify (Blackie, 1951). It was also plentiful at Ellingham in 1857 (Ellis, 1984). Although it has declined throughout its range, this butterfly is still found commonly in Southern and Western England (Heath *et al*, 1984), so some characteristic of Norfolk grassland, or the way in which it is managed, must account for its extinction here.

Arderon's specimens from Norfolk also included the marsh fritillary, a butterfly that was probably never very common in the county, and which vanished from Norfolk in 1974 (Ellis, 1984). Habitat change was undoubtedly responsible for its demise. The purple emperor was another species that gave up its struggle for survival in Norfolk during the 1970's, as did the chalk hill blue (Hall, 1991). The last site for this species was one to which it had been introduced (Ellis, 1984), and all the evidence indicates that the species was never really at home here.

Although the butterflies are the best documented insects, and therefore able to provide the most detail about their changing fortunes, moths have not been neglected. It's probably true to say that those who study moths are more obsessive about their subjects. After all, no butterfly enthusiast would entertain the idea of spending a dark and dismal night hauling heavy items of equipment through some mosquito-infested bog in order to record the equivalent of a large white and two gatekeepers. Yet the moth men do it all the time. I say moth men because there are very few ladies who enjoy the sport. Whether this is due to some physiological difference, or whether it's just a matter of who has more common sense, is not for me to say.

Marked differences between the sexes is a suitable subject with which to introduce the gypsy moth. This was once abundant in the Fens and Broads, and was recorded from Horning by Wigham (1829). Barrett (1901) also refers to its former presence there, but notes that it disappeared at some unknown date. The most recent record for Norfolk was at Cawston, where it survived until 1861 (Barrett, 1874). The last record for the native moth in Britain was in 1907, in a wood in Huntingdon (Skinner, 1984). Since then, migrant males have been taken sparingly, mainly in Southern England. It is thought that the British race of the gypsy moth preferred sweet gale and creeping willow to the forest trees on which it is such a pest on the continent and particularly in North America (Skinner, 1984). In this way it parallels the fondness of the British swallowtail for milk parsley and the large copper for great water dock. On the continent these species feed on a wider variety of food plants, and are consequently found in a wider variety of habitats (Heath *et al*, 1984). No one has yet put forward a

satisfactory explanation for the gypsy moth's demise, but there may be some genetic reason. Barrett (1874) quotes a long passage from Curtis who describes how, as a boy, he found the moth at Horning on sweet gale. There were eggs, caterpillars of all sizes, cocoons and adults of both sexes. For a single-brooded species, this might indicate that something had gone wrong with its breeding cycle control system. Apparently dispersal of the moth is "*by the young hairy larva, which can be carried by a strong breeze for many miles*" (Skinner, 1984). No wonder it was such a favourite with lepidopterists.

In contrast to the gypsy's tale, the story of the Breckland moths makes sober reading. A full account of recent studies by Gerry Haggett and Mike Hall will appear in this year's *Transactions* (Haggett & Hall, 1993). Extinctions, at least in Norfolk, are the order of the day for the Breckland specialities, and habitat degradation and destruction are to blame. The spotted sulphur and viper's bugloss moths are among the species whose dependence on an agricultural system no longer practised has led to their disappearance from this country.

Fenland moths have fared better, with recent records of the scarce vapourer, marsh carpet and five-spot burnet moths from Broadland. All of these species had been feared extinct in Norfolk within the last twenty years, but their decline was more apparent than real. It is pertinent that the scarce vapourer was "rediscovered" as a caterpillar (Saul, 1985), and that the marsh carpet was confirmed as a resident, following the capture of an adult at light, by searching for and finding caterpillars on the developing seeds of meadow rue. That the five-spot burnet, and not just the narrow-bordered five-spot burnet, still occurred in Broadland was proved by examination of cocoons following observations on the food plant of the caterpillars (D.Hipperson & K.Saul, pers.comm.). Recording moths just by using light traps may lead to erroneous conclusions about their distribution and abundance. A knowledge of the species' biology and some effort to find the caterpillars can be a more effective way of establishing current status.

This is not always the case, however. The reed leopard moth has a caterpillar that is an internal feeder in reed stems, and is consequently very difficult to find. The females are seldom trapped at light, but the males are usually attracted, so the presence of the species is straightforward to establish (Waring, 1988). Before light-trapping became a standard method, it was not so easy to determine its distribution. In 1874, Barrett noted no records from Norfolk, but went on to suggest "*As the speedy extinction of most of these species in the Cambridge fens is a matter of probability amounting almost to certainty, it would be of great service to Entomology that they should, if possible, be transplanted into the fens of Norfolk, where they would have room to increase and multiply.*" He goes on to say that he has already attempted this. Whether this was a success is difficult to judge, because it transpired that not only were males caught at Ranworth some ten years later, but also at Horsey and Hickling later still. Barrett himself (1901) suggested this evidence might support the notion that the reed leopard was native in Norfolk. Incidentally the moth still occurs in both Wicken and Chippenham Fens, but I think Barrett was right to be pessimistic about its future.

A closely related species, but one that is more likely to be noticed as a caterpillar is the goat moth. This is a large species, well known to Arderon (1740-60), Wigham (1829) and the Pagets (1834). Barrett (1884) describes it as occurring "*probably everywhere. At Norwich and in many other places, the trunks of ash, oak, willow and poplar and other trees are completely riddled with the burrows of the larvae*

of this species." Affected trees not only ooze a frothy sap in the autumn - they also smell of goats - so it is difficult not to notice them. However recent records of this species are infrequent, and it has evidently undergone a decline. Why this should be so is unknown. Perhaps the dreadful sanitary urge to cut down and burn anything "diseased" may be taking a greater toll than we realise.

This craving for order in the countryside has led to the removal of many hedges in the county. Those that remain are usually treated to a trim of the worst kind, and no doubt the ordered lives of many insects have suffered the flail. It was the modern treatment of hedges that was thought to have led to the decline of the small eggar (Heath, 1974), but a recent comeback, often on thoroughly flailed hedgerows indicates that some other cyclical force, perhaps parasites or disease, may have been at work (M. Hall, pers.comm). The small eggar caterpillar is a social insect, living in large colonies, and is thus particularly vulnerable to such controlling agents.

Of course when we think of modern, tidy hedges, *leylandii* springs to mind. Here too in our very own gardens, the neatly manicured rows of ornamental conifers are having their effect. Two insects - the juniper shield bug and the juniper carpet moth - had restricted ranges in Britain, feeding on wild juniper, but the abundance of garden equivalents (with free transport thrown in) has resulted in a dramatic spread of both . Two new moth arrivals have also spread in much the same way. Blair's shoulder-knot feeds on cypress, including *leylandii*, while the varied coronet has a taste for sweet williams (Skinner, 1984).

Other additions to the county's moth list result from a more careful examination of what we already have. The gold spot might now be Lempke's gold spot, or the copper underwing might be the recently recognised Svensson's copper underwing (Skinner, 1984). Occasionally the reverse happens, and we lose a species to synonymy, but I can't think of any good examples.

Until recently interest in the dragonfly fauna of the county was shown by only a few all-round entomologists, but within the last ten years, a new breed of part-time entomologist has emerged. In spring or autumn birds take priority, but in the lazy summer months, butterflies and particularly dragonflies are the quarry. As the results from the Norfolk Dragonfly Survey (Milford & Irwin, 1990) came in, so the excitement mounted. Was the beautiful demoiselle still found in Norfolk? It wasn't. Could the small red damselfly be found at more than one site? It couldn't. Was the scarce emerald damselfly really extinct? It wasn't. Was the Norfolk damselfly really extinct? It was.

It was difficult to judge the extent to which dragonfly numbers had changed. Even Balfour Browne's (1904) meticulous account of Broadland dragonflies in 1903 lacks information on abundance. However some changes in status within the last hundred years were obvious. The Norfolk damselfly and the beautiful demoiselle were extinct in the county. In both instances changes in habitat, probably involving water quality were likely to be the cause. Neither species had ever been common, and the Norfolk damselfly was restricted to one area of the Broads. A suggestion has been made that it may have been a temporary colony which became established and then died out naturally. This was certainly the case with the migrant yellow-winged darter which established a small colony at Alderfen in the mid-40's (Ellis, 1948). More recent records have all been of odd individuals. The downy emerald and the small red damselfly had only ever been recorded from a few sites in the county, but by the time of the survey, they were

down to one site each. There is great concern about the small red damselfly at Scarning, which is the only East Anglian site for the species, and where existing and proposed roads have damaged the site and may do so further.

The scarce chaser and scarce emerald damselfly were both thought to be extinct in Norfolk before the survey started (Merritt, 1983), but both were shown to be well-established at a number of sites. In the case of the scarce chaser, the sites are remote from its original haunts in the northern Broads. This must be attributed to a decline in water quality throughout much of Broadland, and the species is now restricted to good-quality dykes. The black-tailed skimmer was formerly uncommon in Broadland, but seems to have taken over from the scarce chaser in many areas. It has also enjoyed an increase in suitable habitat by exploiting gravel-pits (Milford & Irwin, 1990).

There is some evidence that the ruddy darter is more widespread than it used to be, and it is certainly abundant in the areas of ponds within pine forests. The migrant hawker was not mentioned by Edwards in 1901, and until the 1930's it was an irregular visitor. However in 1935 a massive migration resulted in the establishment of breeding colonies, which have expanded across the county (Mendel, 1992; Milford & Irwin, 1990).

Although the destruction of ponds and pollution of much of Norfolk's water must have reduced the overall number of dragonflies, the distribution of the other species seems to have changed little in recent times.

The dragonfly survey gathered data from a large number of observers, but one-man surveys can have their place too. In 1967 Plowright published the results of a survey of Norfolk bumblebees made during the years 1960 to 1964. Plowright failed to find two species recorded by Bridgman in 1879. *Bombus subterraneus* and *Bombus distinguendus* were never very common in Norfolk, and both species have experienced major declines nationally. In view of more recent anxieties about the future of British bumblebees, it is time to update Plowright's thirty-year-old survey of the county's fauna.

The status of the hornet has changed recently. From being rare in the county twenty years ago, it has become frequent, if not common. This is a national trend, and is probably due to some climatic factor, but it would be nice to think that it also reflects a more tolerant attitude on the part of people who find their nests. The status of the other social wasps has changed little since Bridgman's account of 1879. However there have been two additions to the Norfolk list, both of which are recent colonists in Britain (Irwin, 1990, 1991). *Dolichovespula media* is a large species, intermediate in size between the common wasp and the hornet, and the workers are often largely black with very little yellow. *Dolichovespula saxonica* is similar to, and much more difficult to tell apart from its close relatives. Both species have been expanding their range on the continent, and it seems that they may be the insect equivalents of the collared dove. Having made it to Britain, they have found it to be a suitable place to live. We shouldn't be surprised. A Single European Market is bound to lead to an influx of workers from abroad.

While the wasps have certainly made their own way here, some insects have been unwittingly transported by man. An early example of this is noted by Arderon in 1749, when describing his discovery of cockroaches in Norwich.

"*These I now send were found at a Bakers oven in Norwich, where they swarm in thousands, but that they should not be found at any other, you'll say is very odd, nor*

could I tell how to account for it untill I went to the place where they are in such plenty, and then I found adjoyning to the house where the oven stands, Warehouses, belonging to a considerable dealer in tea. This I say gives me great reason to suspect the ova of these insects hath been brought from China, some of which by accident may have been scattered nigh this oven."

Less than a hundred years later, the Pagets (1834) note that the oriental cockroach is found "*in most houses*" in Yarmouth, and at least one member of this Society remembers the sight of swarming cockroaches in a Cromer bakery (K. Durrant, pers.comm.). The fortunes of other domestic insects have varied widely.

The house cricket was described by the Pagets (1834) as "*in some bake-offices, very common*". Edwards (1901) thought it "abundant" and it probably remained so until standards of hygiene improved during the 1950's. It then became rarer indoors, but continued to survive on rubbish tips, where the warmth and plentiful food provided the right conditions (Marshall & Haes, 1988). Changes in the way that rubbish is treated have destroyed that particular habitat, and the species retreated to the less accessible parts of hospital ducting, at least in Norwich. However there is every possibility that its cheery song will brighten up many more homes in the county. As the keeping of exotic pets becomes more widespread, so the escape of live food will lead to the establishment of colonies, not just beside the hearth, but in every room of our centrally heated houses.

Other domestic pests, such as the brown house moth and the black carpet beetle have probably changed little in status. In 1893 Edwards described the latter as "*very common in old houses*". Judging from the number of specimens sent to me for identification, it is still very common in old houses, exactly one hundred years later. On the other hand the bacon beetle is no longer resident in Norfolk, due to the almost ubiquitous use of refrigerators for the storage of cured meats. For the same reason, the cheese skipper fly may have disappeared from the county, and eating a piece of cheese has become a less moving experience. In both instances, close relatives of these food pests still occur on dried carcasses, such as those on a gamekeeper's gibbet, where they find the natural equivalents of streaky-back and Camembert.

The commonest food pest in Norfolk is undoubtedly the biscuit beetle. This species was the "weevil" of ships' biscuits, so it is not surprising that it was described as "common" by the Pagets (1834). From his home in early 20th-century Norwich, however, Thouless (1902) recorded that it was "*not often seen, and is only included in the Norfolk list on the strength of an old record*". Edwards (1893, 1901) quotes the Pagets (1834) and cites no other records. Does this mean that the species was rare during the late 19th and early 20th centuries, or does it mean that Thouless and his entomological predecessors were simply not allowed in the kitchen?

As often as not, the term "black beetle" is used these days to describe ground beetles which have accidentally wandered indoors from the garden. When the oriental cockroach was common in houses, it laid claim to the name (Marshall & Haes, 1988). However there was a beetle described by Edwards (1901) as "*a dull black insect about an inch long, of slow movement and unpleasant odour*" which "*shares with the cockroaches the name of black-beetle*". The cellar beetle is apparently rare in Norfolk today, though Edwards (1893) considered it very common in

old houses. The contrast between its fate and that of the black carpet beetle, to which Edwards granted the same status, is a reflection of their different habits. An old, damp cellar with a bit of decaying vegetable matter is increasingly difficult to find, whereas a warm, dry carpet containing some wool is usually there for the eating.

No doubt Sir Thomas Browne was familiar with the sight and smell of "black-beetles", though it was an unusual capture which he records in the following passage (Browne, 1668). "*A Scarabaeus capricornis odoratus which I take to be mentioned by Moufetus... I have taken some abroad one in my Seller which I now send ... to me it smelt like roses santalum and ambergris.*" This reference to the musk beetle is interesting, but it tells us little of its status in Norfolk during the 17th century. Edwards in 1893 regards the species as very local, and its status seems to have changed little since then. The larvae of this beetle develop in the branches of willows, often in old pollards, and as long as the habitat is available then the species should survive.

Two other longhorn beetles have become more common in recent years. *Agapanthia villosoviridescens* was recorded by Stephens (1827-35) in the early 19th century as "*found abundantly in some parts of Norfolk*", but the Pagets (1834) entry reads "*turf-meadow, Oby, July; rare*", and this is the only site noted by Edwards (1893, 1901). During the 20th century it was recorded sparingly at several sites in the Broads, but within the last twenty years it has become much more frequent. *Agapanthia* is a large, conspicuous species, fond of sitting on flowers, so it is most unlikely that it was overlooked by Edwards and Thouless. The food plants include hogweed and wild parsnip, so some other factor must have been responsible for its demise during the last century, and its increase recently.

Thouless first recorded *Leptura rubra* as a British species from specimens collected by him from Scots pine stumps at Horsford in 1918 (Long, 1920), but it now occurs much more widely, having been found at Holkham, Buxton Heath and many sites in and around the Breckland forests (Foster 1987a, 1987b). Presumably current forestry practice, perhaps combined with some climatic change has enabled this species to become much more widespread and abundant.

For most insects, we have no regular system for measuring abundance. Some data are collected using the Rothamstead network of light traps and suction traps, but most records of abundance are made when there is something special to record. This has always been the case, and it is well to remember that when reading old accounts of insect populations. In 1747, Arderon wrote a letter to Henry Baker about a plague of cockchafers in Norfolk. In it he describes how "*these brown tree beetles in their aurelia or grub state are very pernicious insects and where they pitch upon a piece of ground are to be found in such numbers as is scarce credible. I have seen Closes of fine flourishing grass in summer time become as withered and dry as hay in a few weeks ... Whole closes of turnips often undergo the same fate by the gnawing of these devouring insects, and would think they had a design ... to do all the mischief they could, for when one fixes upon a turnip he only eats the middle small root and then moves on to the next.*" Arderon goes on to relate how a local farmer and his men gathered 80 bushels (640 gallons) of cockchafers in order to destroy them. In a second letter on the subject he writes "*Tho many people burn these flys when they have beat them of the trees, Mr. Ebdins manner of destroying them was to*

spread cloths under the trees where he saw them hanging thick and when beat off to wrap them up in the cloths and to beat them to pieces with wooden [clubs]. I have heard some ingenious persons endeavour to account for the large increase of these insects from the decrease of Rooks in this county which they say greedily devour them in their grub state and that the decrease of those birds hath been occasion'd by most of the antient Rookeries having been destroyed by the large fall of timber trees which hath forced these birds its though[t] to remove to other parts of the kingdom. If this be true, we must not yet expect to get rid of these unwelcome guests." How intriguing that some two hundred and fifty years ago someone in Norwich was speculating on the change in status of a local insect and the reasons for it.

When I was researching for this talk tonight, I scanned the Society's *Transactions* thoroughly, and discovered that just over one hundred years ago, on 29 March 1892, the President of the Norfolk and Norwich Naturalists' Society, F.D. Wheeler, was delivering his address (Wheeler, 1893), from which I quote - "*The subject to which I wish for a few minutes to request your attention tonight, is the change which has taken place in recent times in the distribution of some species of insects. When ... in 1880 Mr Southwell read us a paper giving details of the extinction of native races of men, animals and birds, I was not only much interested in the paper itself, but impressed with the idea that one of the most permanently useful employments of such a society as this is to collect and place on record details of species rapidly becoming scarce or even verging on extinction.*"

Ladies and Gentlemen - Wheeler's statement is just as true today as it was then, and I am sure that this Society and its friends will continue to survey and record the changing fortunes of Norfolk insects.

References

ARDERON, W. 1740-60 Diaries cited by Whalley, P. 1971 William Arderon, F.R.S., of Norwich, an 18th century diarist and letter-writer. *J. Soc. Biblphy nat. Hist.* **6**(1), 30-49.

ARDERON, W. 1747, 1749 Correspondence quoted in Whalley, P. 1971 William Arderon, F.R.S., of Norwich, an 18th century diarist and letter-writer. *J. Soc. Biblphy nat. Hist.* **6**(1), 30-49.

BALFOUR BROWNE, F. 1904 A bionomical examination of the Norfolk Broads. *Trans. Norfolk Norwich Nat.Soc.* 7, 661-673.

BARRETT, C.G. 1874 Fauna and Flora of Norfolk Part V. Lepidoptera. *Trans. Norfolk Norwich Nat.Soc.* **1** (Supplement), 1-80.

BARRETT, C.G. 1884 Lepidoptera of Norfolk in Mason, R.H. *History of Norfolk*. London

BARRETT, C.G. 1901 Insecta, Lepidoptera in Doubleday, H.A. (ed.) *Victoria History of the Counties of England. Norfolk*. Westminster:Constable.

BLACKIE, J.E.H. 1951 The range and distribution of *Agapantes galathea* L. *Entomologist.* **84**, 132-135.

BRIDGMAN, J.B. 1879 Fauna and Flora of Norfolk Part IX. Hymenoptera. *Trans. Norfolk Norwich Nat.Soc.* **2**, 617-638.

BROWNE, T. [1662, 1668] Notes on certain fishes and marine animals found in Norfolk. in Browne, T. 1901 *Notes and letters on the Natural History of Norfolk more especially on the Birds and Fishes from the MSS of Sir Thomas Browne, M.D.* London: Jarrold & Sons.

DENNY, H. 1825 *Monographia Pselaphidarum et Scydmaenidarum Britanniae*. Norwich: S. Wilkin.

DURRANT, K.C. 1960 Norfolk Asilidae (Robber Flies). *Trans Norfolk Norwich Nat. Soc.* **19**, 177-178.

EDWARDS, J. 1893 Fauna and Flora of Norfolk Part XII. Coleoptera. *Trans. Norfolk Norwich Nat.Soc.* **5**, 427-508.

EDWARDS, J. 1901 Insecta, Orthoptera, Odonata and Coleoptera in Doubleday, H.A. (ed) *Victoria History of the Counties of England. Norfolk.* Westminster:Constable.

ELLIS, A.E. 1948 Fauna and flora of Norfolk. Dragonflies. *Trans. Norfolk Norwich Nat. Soc.* **16**(4), 331-332.

ELLIS, E.A. 1983 Aphids hit tree lupins. *Eastern Daily Press*, 2 July 1983.

ELLIS, E.A. 1984 Butterflies of Norfolk in the 19th and 20th centuries. *Trans. Norfolk Norwich Nat. Soc.* **26**, 321-334.
FOSTER, A.P. 1987a *Review of Invertebrate sites in England, Norfolk Breckland and South Norfolk.* Unpublished report to Nature Conservancy Council.
FOSTER, A.P. 1987b *Review of Invertebrate sites in England, Norfolk Broadlaud.* Unpublished report to Nature Conservancy Council.
HAGGETT, G.M. & HALL, M.R. 1993 The effect of Pine Afforestation *Trans. Norfolk Norwich Nat. Soc.* **29**(5), 382-406.
HALL, M.R. 1991 *An Atlas of Norfolk butterflies*, 1984-1988 Norwich: British Butterfly Conservation Society,Norfolk Branch
HEATH, J. 1974 A century of change in the Lepidoptera. in Hawksworth, D.L. (ed.), *The changing flora and fauna of Britain. Systematic Association Special Volume* 6, 275-292.
HEATH, J., POLLARD, E. & THOMAS, J.A. 1984 *Atlas of Butterflies in Britain and Ireland.* Harmondsworth: Viking
IRWIN, A.G. 1983 *Bibloplectus minutissimus* Aube.(Col., Pselaphidae) in East Anglia. *Entomologists mon. Mag.***119**, 214
IRWIN, A.G. 1984 The Large Copper, *Lycaena dispar dispar* (Haworth) in the Norfolk Broads. *Entomologist's Rec.J.Var.* **96**, 212-213.
IRWIN, A.G. 1990 *Dolichovespula media* - a social wasp new to East Anglia. *Trans. Norfolk Norwich Nat. Soc.* **28**(5), 390.
IRWIN, A.G. 1991 Further records of *Dolichovespula* wasps in Norfolk including a second British record of D. saxonica. *Trans. Norfolk Norwich Nat. Soc.* **29**(1), 32.
LONG, S.H. 1920 Two rare beetles. *Trans. Norfolk Norwich Nat. Soc.* **11**, 101.
MARSHALL, J.A. & HAES, E.C.M. 1988 *Grasshoppers and allied insects of Great Britain and Ireland.* Colchester: Harley Books.
MENDEL, H. 1992 *Suffolk Dragonflies.* Ipswich: Suffolk Naturalists Society.
MERRITT, R. 1983 in Hammond, C.O. *The Dragonflies of Great Britain and Ireland.*(2nd Edition) Colchester: Harley Books.
MILFORD, P.J. & IRWIN, A.G. 1990 The dragonflies of Norfolk. *Trans. Norfolk Norwich Nat.Soc.* **28**(5), 357-380.
MORLEY, C. & ATMORE, E.A. 1915 The Diptera of Norfolk and Suffolk. *Trans. Norfolk Norwich Nat. Soc.* **10** (Supplement), 1-180.
PAGET, C.J. & PAGET, J. 1834 *Sketch of the natural history of Yarmouth* ... Yarmouth: Skill
PLOWRIGHT, R.C. 1967 On the distribution of bumblebees in Norfolk. *Trans. Norfolk Norwich Nat.Soc.* **21**(1), 48-88.
RICHMOND, D.I. & IRWIN, A.G. 1991 The grasshoppers and crickets of Norfolk. *Trans. Norfolk Norwich Nat.Soc.* **29**(1), 53-70.
SAUL, K.G. 1985 Rare moths in Broadland.*Trans. Norfolk Norwich Nat.Soc.* 27(1), 66.
SHIRT, D.B. (Ed.) 1987 *British Red Data Books. 2 Insects.* Peterborough: Nature Conservancy Council
SKINNER, B. 1984 *Colour Identification Guide to Moths of the British Isles.* Harmondsworth: Viking.
SOUTHWELL, T. 1901 in Browne, T. *Notes and letters on the Natural History of Norfolk more especially on the Birds and Fishes from the MSS of Sir Thomas Browne,* M.D. London: Jarrold & Sons.
STEPHENS, J.F. 1827-35 *Illustrations of British Entomology.* Mandibulata. 7 Vols. London.
THOULESS, H.J. 1902 Miscellaneous notes. *Trans. Norfolk Norwich Nat. Soc.* 7, 426.
THOULESS, H.J. 1921 The Mole Cricket. *Trans. Norfolk Norwich Nat. Soc.* **11**, 219.
WARING, P. 1988 *Moth Conservation Project News Bulletin* 1. Peterborough, Nature Conservancy Council.
WHEELER, F.D. 1893 President's address. *Trans. Norfolk Norwich Nat. Soc.* **5**, 231-249.
WIGHAM, R. 1829 in Chambers, *A General History of the County of Norfolk, intended to convey all the Information of a Norfolk Tour*...Norwich:John Stacey

Appendix 1
Scientific names of insects mentioned in the text.

bacon beetle *Dermestes lardarius*
beautiful demoiselle *Calopteryx virgo*
biscuit beetle *Stegobium paniceum*
black carpet beetle *Attagenus pellio*
black-tailed skimmer *Orthetrum cancellatum*
black-veined white butterfly *Aporia crataegi*
Blair's shoulder-knot *Lithophane leautieri*
brown house moth *Hofmannophila pseudospretella*
bumble bee *Bombus subterraneus*
bumble bee *Bombus distinguendus*

cellar beetle *Blaps mucronata*
chalk hill blue *Lysandra coridon*
cheese skipper fly *Piophila caesei*
cockchafer *Melolontha melolontha*
comma *Polygonia c-album*
copper underwing *Amphipyra pyramidea*
downy emerald *Cordulia aenea*
elm bark beetle *Scolytus scolytus*
five-spot burnet moth *Zygaena trifolii*
gatekeeper *Pyronia tithonus*
goat moth *Cossus cossus*
gold spot *Plusia festucae*
ground beetle *Carbadae sp.*
gypsy moth *Lymantria dispar*
holly blue *Celastrina argiolus*
hornet *Vespa crabro*
house cricket *Acheta domesticus*
juniper carpet moth *Thera juniperata*
juniper shield bug *Cyphostethus tristriatus*
large copper butterfly *Lycaena dispar*
large marsh grasshopper *Stethophyma grossum*
large tortoiseshell *Nymphalis polychloros*
large white *Pieris brassicae*
Lempke's gold spot *Plusia putnami*
longhorn beetle *Agapanthia villosoviridescens*
longhorn beetle *Leptura rubra*
lupin aphid *Macrosiphum albifrons*
marbled white butterfly *Melanargia galathea*
marsh carpet *Perizoma sagittata*
marsh fritillary *Eurodryas aurinia*
mole-cricket *Gryllotalpa gryllotalpa*
migrant hawker *Aeshna mixta*
musk beetle *Aromia moschata*
narrow-bordered five-spot burnet *Zygaena lonicerae*
Norfolk damselfly *Coenagrion armatum*
oriental cockroach *Blatta orientalis*
pselaphid beetle *Bibloplectus minutissimus*
reed leopard moth *Phragmataecia castaneae*
robber fly *Asilus crabroniformis*
ruddy darter *Sympetrum sanguineum*
scarce chaser *Libellula depressa*
scarce emerald damselfly *Lestes dryas*
scarce vapourer *Orygia recens*
sheep nostril fly *Oestrus ovis*
small eggar *Eriogaster lanestris*
small red damselfly *Ceriagrion tenellum*
social wasp *Dolichovespula media*
social wasp *Dolichovespula saxonica*
speckled wood butterfly *Pararge aegeria*
spotted sulphur moth *Enmelia trabealis*
Svensson's copper underwing *Amphipyra berbera*
swallowtail butterfly *Papilio machaon*
varied coronet moth *Hadena compta*
viper's bugloss moth *Hadena irregularis*
white admiral *Ladoga camilla*
white-letter hairstreak *Strymonidia w-album*
yellow-winged darter *Sympetrum flaveolum*

NORFOLK PLANT RECORDS 1992

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Introduction

Work on the new Flora continues and has produced many hundreds of records, some of plants found in the past and others quite new. In the first category it is good to know that purple broomrape, *Orobanche purpurea* and sand catchfly, *Silene conica* continue to thrive at Beeston Regis. A small saltmarsh grass, *Parapholis incurva* was spotted by ALB exactly where found by Charles Hubbard in 1937, while grey hair-grass, *Corynephorus canescens* is still on the Denes at Yarmouth (YN) and bulbous meadow-grass, *Poa bulbosa* at Heacham (PC). One of only two remaining sites for maiden pink, *Dianthus deltoides* was checked this summer (KA & GB) using a letter dated 1951 and found to be doing well and round-leaved wintergreen, *Pyrola rotundifolia*, is still to be found on Winterton dunes (RS). The drought lowered the water levels of Perch Lake, Westwick exposing a sandy shore with shoreweed, *Littorella uniflora* last recorded at this its only East Norfolk site in the mid 1950s (PWL & LM).

New trends in plant distribution are apparent from the occurrence of salt-marsh plants along our main roads and ETD found the grass-leaved orache,

Atriplex littoralis, in the centre of Norwich. Danish scurvygrass, *Cochlearia danica* and reflexed salt-marsh grass, *Puccinellia distans*, are travelling fast along the A47 and other main roads and we now await the first record of the sea spurrey, *Spergula marina*, which is on the roadsides in Cambridgeshire. Another plant which is spreading fast is the prickly lettuce, *Lactuca serriola*.

Although the line drawn down the middle of Norfolk to separate East and West is an arbitrary one, it is surprising how different the floras are. Marsh mallow, *Althaea officinalis* for example is noted to be common along the Thurne (GK), yet the find at Marshland St James (RMP) is the first West Norfolk record since 1957, while small medick, *Medicago minima*, frequent in the west is at Honingham Breck (ALB) in its only East Norfolk station. Milk parsley *Peucedanum palustre* so familiar in the Broads turned up at Middleton (HW) and Shouldham (RMP), while fine-leaved sandwort, *Minuartia hybrida*, a scarce plant of the Breckland heaths was at New Buckenham Castle (ALB).

Introduced plants can sometimes be confused with native ones and their status is not always easy to decide. Cornflowers on road verges are almost always the result of misguided scattering of wildflower seed, but corn cockle, *Agrostemma githago*, is more of a problem as it can be a genuine weed as well as a garden escape. It was found this year at Hempnall (MC). By using Stace (1991) many introduced plants formerly so difficult to identify in books are now set out clearly and it would be worth trying to sort out the Michaelmas daisies, *Aster* species and goldenrods, *Solidago* species which are to be found throughout the county. One odd find was red-hot poker, *Kniphofia uvaria* which was found at Mattishall (ALB) and Colkirk (KAB).

At Hunstanton, the occurrence of a rare peloric form of the marsh orchid, *Dactylorhiza praetermissa*, with no lip but all outer petals alike, noted by Dr. M. Fellowes, brought the experts hurrying. Curious forms are always worth investigating.

Geltman (1992) drew attention to *Urtica galeopsifolia* which is believed to be the true wild stinging nettle species. It is characterised by the lack of stinging hairs and has much narrower leaves than those of the familiar plant. It is native to fen areas and carr and was until recently considered to be just a form of the common stinging nettle, *U. dioica*. The first record for the county was made by ETD at Thorpe St Andrew in 1991 and this year additional sites were found at Wheatfen (ALB) and Blackborough End (HW). It is likely that it will be found to be widespread in suitable habitats throughout the county.

The list below is a selection of records received. All records given follow the order and nomenclature of Stace (1991).

Dryopteris affinis ssp *borreri* TG01 Hockering ALB; TG10 Ketteringham SM.
Polystichum setiferum TG32 Worstead KAB.
Blechnum spicant TG01 Hockering ALB.
Aquilegia vulgaris TG00 Reymerston ALB.
Berberis thunbergii TG14 Sheringham FF.
Papaver hybridum TG63 Heacham JA.
Pseudofumaria alba TF80 Holme Hale D & BM.
Fumaria parviflora TF72 Flitcham R & EC; TF63 Sedgeford JA; TL99 Carbrooke DM0.
Amaranthus retroflexus TF74 Ringstead PC; TL79 Foulden JG.

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Montia fontana TG01 Hockering ALB.
Lychnis coronaria TF70 Gooderstone JG.
Saponaria ocymoides TF61 Kings Lynn RMP.
Malva pusilla TF70 Oxborough JG, first vice-county record.
Persicaria minor TG03 Fulmodeston JRA.
Rumex maritimus TL89 Lynford JG; TG20 Whitlingham GK.
Rumex palustris TF61 Kings Lynn CRS
Rumex patienta TG50 Gorleston KR.
Hirschfeldia incana TM09 New Buckenham Castle ALB; TG50 Yarmouth Denes YN.
Lepidium heterophyllum TF71 Marham JW, second vice-county record.
Lepidium latifolium TG40 Haddiscoe Island JH.
Erucastrum gallicum TF50 Stow Bridge GB.
Turritis glabra TL88 Santon Downham KA & GB.
Anagallis arvensis ssp. *foemina* TL79 Weeting SR.
Crassula tillaea TG01 Swanton Morley gravel pits D & BM.
Potentilla recta TF70 Cockley Cley MA; TG14 Sheringham FF.
Prunus serotina TF63 Snettisham PC; TL88 Barnham Cross Common KAB.
Rubus anisacanthos TG01 Hockering ALB, new to Norfolk.
Rubus britannicus TG13 Wolterton ALB, new to vice-county.
Rubus crudelis TG13 Saxthorpe ALB, new to Norfolk.
Rubus fissus TG23 Southrepps Common ALB, second vice-county record.
Rubus glareosus TG14 Beeston Common ALB, second vice-county site.
Rubus leucostachys TG14 Sheringham ALB, new to Norfolk.
Rubus lintonii TG01 Hockering ALB; TF71 Houghton ALB.
Cotoneaster bullatus TL79 Cranwich KAB.
Genista tinctoria TM29 Hardwick airfield ALB.
Epilobium lanceolatum TF60 Stradsett RMP, second vice-county record.
Geranium columbinum TL79 Foulden KAB; TF61 Leziate CRS; TF72 Flitcham R & EC.
Geranium rotundifolium TL88 Thetford NG & MG.
Geranium versicolor TF93 Fulmodeston MK.
Apium graveolens TG10 Wramplingham ALB, far from its usual coastal habitat.
Scandix pecten-veneris TM29 Hardwick airfield and Hempnall ALB.
Blackstonia perfoliata TL68 Feltwell JS, first vice-county record.
Atropa belladonna TF70 Beechamwell JG; TF50 Denver HW.
Calystegia pulchra TF81 Litcham Common KAB.
Nymphoides peltata TF42 Winterton Dunes RS.
Symphytum tuberosum TG12 Heydon ALB.
Lithospermum arvense TF72 Flitcham R & EC; TF62 Grimston CRS.
Betonica officinalis TM29 Fritton ALB.
Melissa officinalis TF71 Oxborough JG.
Littorella uniflora TG22 Westwick Lakes PW & LM.
Verbascum phlomoides TF71 Oxborough JG.
Veronica praecox TF68 Feltwell JS, extension of known site.
Scrophularia umbrosa TL89 L. Langford and Bodney ALB; TL98 W. Harling KA &GB.
Campanula glomerata TF70 Beechamwell JG.
Campanula rapunculoides TF80 Cockley Cley MA; TF63 Sedgeford JA.

Galium parisiense TL88 Thetford JG; TL78 Hockwold KAB; TL89 Little Langford ALB.
Leycesteria formosa TG20 Mousehold Heath, Norwich WFS.
Lonicera x italica TL88 Barnham Cross Common NG.
Valerianella dentata TL79 Methwold Warren JG & GB; TF72 Flitcham R & EC.
Bidens cernua var. radiata TG01 Sparham Pools ALB.
Hieracium lanatum TG50 Great Yarmouth CL.
Hieracium scotostichon TG11 Taverham JHu.
Senecio squalidus x vulgaris TF64 Hunstanton PC.
Crepis biennis TF90 Cranworth ALB.
Baldellia ranunculoides TF61 Setch JW.
Stratiotes aloides TF70 Caldecote MK.; TM29 Fritton Common ALB.
Potamogeton alpinus TF61 Shouldham HW.
Ruppia spiralis TG04 Cley KKH., Salthouse ALB.
Juncus tenuis TF70 Oxborough JEG; TG32 Worstead KAB.
Eleocharis multicaulis TG31 Bure Marshes RS.
Carex lasiocarpa TG31 Bure Marshes RS.
Festuca arenaria TG32 Lessingham WFS; TG50 Yarmouth North Denes YN.
Vulpia ciliata var ambigua TM17 Fair Green, Diss NNNS.
Vulpia fasiculata TG50 Yarmouth North Denes YN.
Phalaris paradoxa TF60 Fincham MK. Second vice-county record.
Polypogon monspeliensis TG30 near Strumpshaw tip JD.
Bromus secalinus TM29 Hardwick airfield, Hempnall ALB.
Anisantha rigida TF93 Kettlestone MK; TL78 Weeting MK; TL98 Kilverstone GB; TG50 Yarmouth North Denes YN.
Paris quadrifolia TL99 Breccles KA & GB; TG01 Hockering ALB; 03 Swanton Novers Great Wood PWL.
Ornithogalum nutans TF94 Wells sea bank PB.
Muscari neglectum TM29 Hardwick airfield, Hempnall ALB.
Leucojum vernum TG00 Reymerstone Churchyard ALB.

References

STACE, C. 1991 *New Flora of the British Isles* Cambridge University Press
GELTMAN, D.V. 1992 *Urtica galeopsifolia* Wierzb. ex Opiz (Urticaceae) in Wicken Fen (E. England) *Watsonia* **19**(2) 127-129

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ALB	Alec Bull	NNNS	Norfolk & Norwich Nat. Soc
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JG	Jean Gaffney	RS	Rick Southwood
NG	Nick Gibbons	CRS	Robin Stevenson

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FRESHWATER RECORDER'S REPORT

R. J. Driscoll

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1992 produced a few interesting records of aquatic invertebrates.

Ranatra linearis (L.)

This uncommon water bug was recorded from three localities in 1992.
L. A. Dear recorded nymphs of *Ranatra linearis* from Hickling Broad National Nature Reserve (TG429217). She caught the bugs while 'pond dipping' with parties of school children during May and June in the same area that she had caught adult bugs in 1991.

Dear also recorded nymphs from the artificial lake in the conservation area on the Royal Norfolk Show Ground (TG1410) on 3 and 4 July. The lake was created in 1989 and stocked with plants collected from dykes at Ranworth (TG366147), which may be the source of the insects.

I. Wilson, a student at the University of East Anglia, caught a single adult while collecting water bugs from a pond at Swannington Common (TG144181) on 15 September.

Aeshna grandis (L.) feeding on *Sympetrum striolatum* (Charpentier)

On 6 August L. A. Dear saw a specimen of *Aeshna grandis* flying over the marshes south-west of Potter Heigham (TG4118). The insect had caught something very large and was having difficulty flying. It landed and Dear was able to watch it feeding and identified its prey as another dragonfly, *Sympetrum striolatum.* Although it is smaller tham *A. grandis, S. striolatum* is nevertheless a large insect and is probably about the largest prey that *A. grandis* would be able to take.

Plumatella fungosa (Pallas)

On 25 August J. M. Parmenter and R. J. Driscoll were surveying the marginal vegetation of Ormesby Broad when their boat's propeller fouled on a fyke net strung across the north end of the broad (TG468167). Part of the net was hauled into the boat and examined. Apart from two very lively eels and a number of small dead or dying roach the net was festooned with what appeared to be lumps of sponge. On closer examination these turned out to be colonies of the bryozoan *Plumatella fungosa.*

M. J. Jackson and R. J. Driscoll found this species on waterlogged rope in Malthouse Broad in 1982. Although *P. fungosa* is usually found on solid substrates, such as submerged branches or piling, it seems that submerged rope is an acceptable alternative substrate. There is probably no shortage of waterlogged rope in the broads and *P. fungosa* may be more common in Broadland than recent records suggest.

***Cordylophora caspia* (Pallas) [=*Corylophora lacustris* Allman]**

This brackish water hydrozoan is widely distributed in the tidal reaches of the Broadland rivers. Although it is usually found attached to piling it has occasionally been recorded from reed stems. *Cordylophora caspia* is common along the River Bure upstream at least as far as the mouth of the River Ant. It is less common along the River Yare upstream as far as Strumpshaw, and has been found at Potter Heigham on the River Thurne and at Haddiscoe on the River Waveney.

In the Horsey area saline groundwater enters the drainage dykes and is pumped into the river system, making the Thurne broads slightly brackish. On 24 August 1990 G. C. B. Kennison carried out a survey of aquatic macrophytes in Horsey Mere for the Broads Authority. He found *C. caspia* attached to *Potamogeton perfoliatus* L. pulled up from the bottom of the broad (TG4422) [Kennison, G. C. B. 1991 *Aquatic macrophyte surveys of the Norfolk Broads 1990.* Report prepared for Broads Authority]. Although Kennison has surveyed the aquatic macrophytes in Horsey Mere annually since 1983 this is the first record of *C. caspia* from the broad since N. C. Morgan recorded it in July 1968.

WEST NORFOLK CHURCH FERNS

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Introduction

During the years 1991 and 1992 I visited all the accessible pre-20th century parish churches in West Norfolk (VC 28) listed by Pevsner (1962), a total of 273 sites, this number excluding churches that are merely roofless ruins (of which I also visited 23). For visits to a further four churches in the Stanford Training Area in Breckland I am indebted to Gillian and Ken Beckett who kindly supplied me with the relevant data so that they could be included in this paper. My object was to survey the fern flora of these buildings, and to compare the results with those from East Norfolk (Daniels 1986) and from other parts of England.

Unlike Daniels (*op.cit.*) I listed only the ferns growing on the fabric of the churches and on the walls and tombs of the churchyards, i.e. on man-made structures: I did not include ferns growing on earth banks or in boundary hedges, though in fact only a tiny proportion of the sites visited had any ferns growing in these habitats. The only species recorded by Daniels as a church fabric plant which was not seen in West Norfolk is *Dryopteris affinis* (Scaly Male Fern). On the other hand, West Norfolk had two sites with *D. dilatata* (Broad Buckler fern), whereas East Norfolk had none.

Of the 277 sites visited (i.e. excluding ruins) ferns were present at 137 (49% of the total) a similar proportion to the 51% in the East Norfolk survey. Of these 137, 16% had three or more species (11% in East Norfolk), 27% two species (24% in East Norfolk) and 57% only a single species (65% in East Norfolk). Two churches had five species - St. Nicholas, King's Lynn and St. Nicholas, East Dereham. Like Daniels (*op. cit.*) I found that several churches had been recently cleaned and repaired, doubtless to the detriment of their flora, but previous experience of wall flora surveys had already taught me that this is a hazard to be expected in such exercises. There seems no reason to suppose that

this parochial zealousness is not more or less randomly distributed over the whole of the county. However, it should be borne in mind in evaluating the results of the West Norfolk survey that it took place after three abnormally dry years which may have reduced the local population of some of the more moisture-loving species, or at least made them less conspicuous by reducing the size of their fronds.

Results

Table 1 lists the nine species observed, in order of frequency. Nomenclature is that of Stace (1991).

Polypodium interjectum (Intermediate Polypody) is the usual Polypody on Norfolk walls and buildings, but in many of the sites visited these ferns were growing high up on the church tower, so that it was impossible to be sure that *P. vulgare* was not present: I share the view expressed most recently by Stace (*op. cit.*) that identification of the segregate species of this complex usually requires microscopic examination.

An interesting feature of Table 1 is the marked partiality of Polypody and Hart's Tongue for churchyard walls as against the church buildings. Hart's Tongue and Male Fern were the only ferns seen on brick tombs.

There was no appreciable difference between the fern floras of carstone, limestone or flint churches - perhaps not surprisingly since in general the plants on buildings root in the mortar. But there were 15 sites where ferns occurred only on the brick churchyard wall or on brick tombs whilst the stone or flint church itself was devoid of ferns.

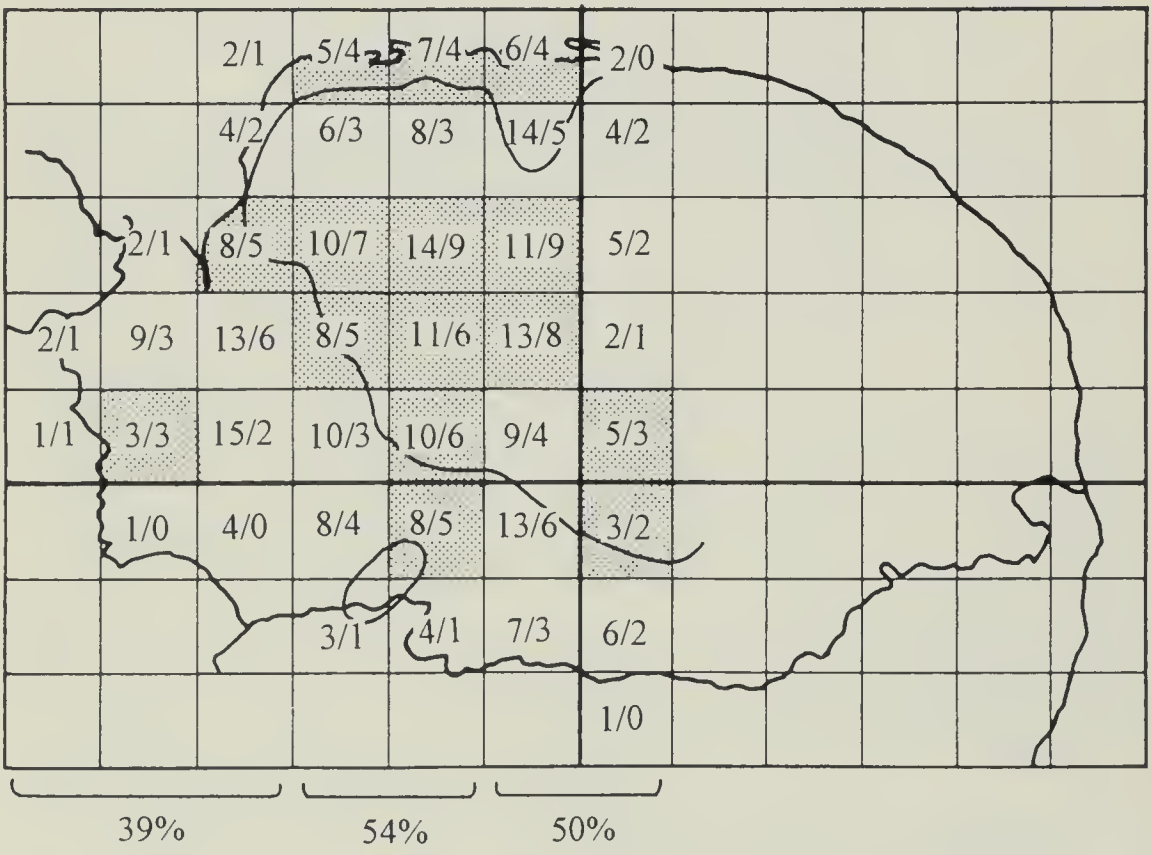
Table 1

	Number of sites	On the church fabric	On churchyard walls or tombs
Asplenium ruta-muraria (Wall Rue)	48	40	11
Dryopteris filix-mas (Male Fern)	44	38	10
Polypodium agg. (Polypody)	38	28	17
Asplenium trichomanes (Maidenhair Spleenwort)	34	31	5
Asplenium adiantum-nigrum (Black Spleenwort)	25	23	3
Phyllitis scolopendrium (Hart's Tongue)	24	14	10
Pteridium aquilinum (Bracken)	2	2	-
Dryopteris dilatata (Broad Buckler fern)	2	1	1
Ceterach officinarum (Rustyback)	1	-	1

Figure 1 shows the geographical distribution of church ferns over the 10 Km squares of the vice-county. The richest squares lie in a NW-SE belt across West Norfolk, and it seems significant that this belt broadly corresponds with the area of heaviest annual rainfall, shown on the figure as bounded by the 650mm and 700mm isohyets. But it will be noticed that the squares in the 30 horizontal

stand out as an exception to this correlation, having a markedly lower proportion of fern-rich sites. Gillian Beckett has suggested that this might be because the villages in this area are few and far between, with a correspondingly smaller number of sites (including secular as well as church walls) available for colonisation by ferns and hence a smaller reservoir of fern spores. Certainly there are 25% fewer churches in this belt than in the 10 Km squares in the 20 horizontal immediately to the south.

Fig. 1 Sites visited/sites with ferns in each 10-km square. Ratio over 50% in shaded squares. Percentages refer to overall ratio in those verticals. Area within curved lines has average rainfall of 650mm and over.



Along the north coast there is another strip of fern-rich squares, presumably at least partly due to the sea mists which often penetrate a few miles inland (Petch & Swann 1968). It is of interest that Gibbons (1975), writing of ferns in the neighbouring county of Lincolnshire, says that churches near the coast are distinctive in having an established fern flora. The figures of percentage cover-

age at the base of Figure 1 show that the most westerly parts of the vice-county - the driest - are on average the least rich.

A notable exception to these patterns is in the distribution of Male Fern, which is more frequent in the dryer west. This fern was noted on 27% of churches in the 40-60 verticals, but on no more than 13% in the 70-00 verticals. Table 2 compares the order of frequency of the species of ferns on West Norfolk churches with those recorded in church surveys in East Norfolk (Daniels 1986), South Essex (Payne 1978), Middlesex (Kent 1964) and North Somerset (Payne 1989).

Table 2

	West Norfolk	East Norfolk*	South Essex	Middlesex	North Somerset
Wall Rue	1	5	4	4	1
Male Fern	2	4	1	1	very rare
Polypody	3	1	5	very rare	very rare
Maidenhair Spleenwort	4	6	very rare	very rare	2=
Black Spleenwort	5	3	3	absent	absent
Hart's Tongue	6	2	2	2	2=
Bracken	7=	7	6	3	absent
Broad Buckler	7=	absent	absent	very rare	4
Rustyback	9	8	very rare	absent	absent

*Ferns growing on the church itself: records of Polypody segregates aggregated

The first four columns of Table 2 all relate to areas with relatively low annual rainfall: only North Somerset is in a wetter part of England. It is interesting to see therefore that Male Fern is shown to be more tolerant of a drier climate, as already suggested. Black Spleenwort may also lie in this category. On the other hand, Maidenhair Spleenwort clearly prefers a wetter regime. Within Norfolk, Maidenhair Spleenwort, Wall Rue and Male Fern were relatively more frequent in the later West Norfolk survey, while Hart's Tongue was more frequent in the earlier East survey. This may suggest that Hart's Tongue is less able than the other three species to survive three years of inadequate rainfall.

All the preceding paragraphs of this paper exclude the 23 ruined churches visited. No ferns were seen on any of these roofless buildings, the majority of which were smothered in ivy which must prevent the survival of any other plants. But the few ruins devoid of ivy were also bare of ferns, though some had other plants growing on them: these ruins were all in very exposed situations and presented a desiccated appearance, obviously lacking the leaking gutters which are sometimes a factor in maintaining the fern flora of churches, and now apparently too dry to sustain any ferns which long ago might have grown there.

Acknowledgements
I am grateful to Gillian and Ken Beckett for helpful comments on the draft of this paper, to Commander Andrew Fountaine for allowing me access to Narford Church, and to Gillian Beckett, Jean Gaffney, Ross Hadow and Terry Mayes for information about Norfolk rainfall. Tony Irwin gave me helpful advice on the presentation of my data in Figure 1.

References
DANIELS, E.T. 1986 East Norfolk Church Ferns *Trans.Norfolk Norwich Nat. Soc.* 27(3), 211-213.

GIBBONS, E.J. 1985 *The Flora of Lincolnshire* Lincoln.
KENT, D.H. 1964 Notes in the Flora of Churchyard Walls in Middlesex. *Lond.Nat* **43**,13-16.
PAYNE, R.M. 1978 The flora of Walls in South Eastern Essex *Watsonia* **12**, 41-46.
PAYNE, R.M. 1989 The Flora of Walls in the Chew Valley *Proc.Somerset Arch.&Nat. hist.Soc* **133**, 231-243
PETCH, C.P. & SWANN, E.L. 1968 *Flora of Norfolk* Norwich: Jarrold
PEVSNER, N. 1962 *The Buildings of England North West and South Norfolk* Penguin Books
STACE, C. 1991 *New Flora of The British Isles* C.U.P.

LOPHOZIA CAPITATA (HOOK.) MACOUN AND *RICCARDIA INCURVATA* LINDB.: TWO LIVERWORTS NEW TO NORFOLK.

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In 1988 a species of *Lophozia* was discovered growing at three separate localities in West Norfolk: in old gravel workings at Blackborough End (53/680145); in the damp bottom of old sand workings at Bawsey (53/667192), and on silty substrates in old quarry workings near Roydon Common (53/680223). At the time they were identified as *Lophozia excisa* (Dicks.) Dum.

The Blackborough End site is a particularly interesting one since it hosts a rich variety of pioneer calcifuge bryophytes. For this reason it has been visited fairly regularly. At intervals the population of *Lophozia* was re-examined, and the original identification became more and more suspect - mainly because *L. excisa* normally has abundant reddish angular gemmae, which, in this instance, were conspicuous by their absence. In January of 1992 it was collected again and gemmiferous shoots were detected. With the aid of the new liverwort flora for the U.K. (Smith 1991), it was finally assigned a name which appeared to make sense i.e. *Lophozia capitata* (Hook.) Macoun.

Lophozia capitata was first described from the British Isles by Jones (1950) who noted the resemblance of the plant to *L. excisa.* The two plants can have overlapping ecologies, and their morphological resemblance is certainly sufficient to cause problems, unless gemmae are present. In *L. excisa* they are angular, and found on the margins of ordinary leaves, whilst in *L. capitata* they are ovoid, and found on the margins of small leaves borne on the end of attenuated shoots. Another difference cited by Smith (op cit.) lies in the presence of 2-3 celled cilia around the mouth of the perianth. These have not been found in the material examined; however, according to Schuster (1969 p. 470) they are "often deciduous at maturity". Some of the plants at Blackborough End have also been found bearing capsules: this has not, apparently, been recorded in British material before.

Long, (in Hill, Preston & Smith 1991) notes that its habitat is "on disturbed damp sandy or clay soil, typically on flat ground in old sand pits where subject to occasional flooding...". This corresponds broadly to the environments in which it has been found in West Norfolk. At Blackborough End, however, some of the plants were found growing on / around the base of old stems of *Typha.* Crum (1991) notes that, in Michigan, it has been found on " the wet base of sedges...". Re-examination of the sites at Bawsey & Roydon has failed to relocate *L. capitata*; in both instances the sites have been much invaded by birch scrub, which,

together with recent weather patterns, has probably dried the sites out too much for the survival of the species.

More recently *L. capitata* has been found growing on sand adjacent to flooded gravel pits at Billingford Common (63/017192) in the Wensum Valley, close to the border with East Norfolk (V.C. 27).

Riccardia incurvata was found growing in close proximity to the *Lophozia*. A similar association has been noted in Belgium, by Schumacker (1985), and in the Netherlands by Landwehr (1980). It is "A species of moist gravelly or sandy soil in open habitats that are generally only sparsely colonised by higher plants.....The substrate may be either acidic or calcareous." (Yeo, in Hill, Preston & Smith 1991).

R. incurvata is another species which is tricky to recognise. It is small and easily overlooked, and differs mainly from the much commoner *R. chamedryfolia* (With.) Grolle in having a concave, semi-lunar cross section.

Like *L. capitata* it appears to be rare in eastern England, but this may simply be due to under-recording. Both are species which should be looked for more widely in Norfolk, wherever sand and gravel pits are found - particularly in damp spots where they have begun to develop a pioneer veneer of bryophytes.

Species closely associated with the *Lophozia* and *Riccardia* include *Blasia pusilla* L.; *Pohlia proligera* (Breidl.) Arnell; *Chiloscyphus polyanthos* var *pallescens* (Ehrh. ex Hoffm.)Hartm.; *Cephaloziella divaricata* (Sm.) Schiffn.; *Cephalozia bicuspidata* (L.) Dum.; *Campylopus introflexus* (Hedw.) Brid., *Dicranella cerviculata* (Hedw.) Schimp., and *Polytrichum piliferum* Hedw.

Both species have been confirmed as correct and new to Norfolk.

References

CRUM, H. 1991. *Liverworts and Hornworts of Southern Michigan*. The University of Michigan Herbarium, Ann Arbor.

HILL, M.O, Preston C. D. & Smith A.J.E. 1991. *Atlas of the Bryophytes of Britain and Ireland. Volume 1 Liverworts*. Harley Books.

JONES, E.W. 1950. *Lophozia capitata* (Hook.) K.M. in Britain. *Trans. Br. bryol. Soc.* 1 (4), 353-356.

LANDWEHR, J. 1980. *Atlas Nederlandse Levermossen*. Koninklijke Nederlandse Natuurhistorische Vereniging.

SCHUMACKER, R. (ed). 1985. *Atlas de Distribution des bryophytes de Belgique, du Grand-Duché, de Luxembourg et des regions limitrophes*. Jardin botanique national de Belgique. Meise.

SCHUSTER, R. M. 1969. *The Hepaticae and Anthocerotae of North America east of the Hundredth Meridian* (Volume 2). New York: Columbia University Press.

SMITH, A.J.E. 1991. *The Liverworts of Britain and Ireland*. Cambridge: Cambridge University Press.

A CHECKLIST OF THE LIVERWORTS OF NORFOLK.

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The following is an alphabetic listing of those species of liverworts which have been recorded from Norfolk, either from one, or both of the vice-counties (East Norfolk VC27, and West Norfolk VC28), up until the present day. Where a plant has only been recorded from one of the vice-counties, then the vice-county number is given.

The list is based on the publications of Petch & Swann (1968), Swann (1975), Swann (1982), and Corley and Hill (1981). More recent records have been published in the July issues of the Bulletin of the British Bryological Society, (1982-1992).

As with the mosses, there have been some discrepancies in recording, notably in that several species noted by Swann are not listed in the British Bryological Society Census Catalogue (Corley & Hill 1981). Again, in order to clarify the position for future recording, species which have not been accepted by the British Bryological Society have been excluded from this list. A few of the species which appear in the Census Catalogue ought to have been placed in round brackets to indicate that the records are more than 50 years old. These species have been so bracketed in this list. They may be regarded as possibly / probably extinct.

As in Stevenson (1992) the primary nomenclature used is that employed by Petch and Swann (1968) and Swann (1975), since these are probably the most readily available sources of bryological information for the majority of people in the county.

The names used by Swann are followed by the most recent changes, and follow the usage of Smith (1991). Full author citations have only been provided for the most recent names.

Additions to the flora since the publication of the Supplement (Swann 1975),are indicated by an asterisk (*). There have been 5 such additions.

The total liverwort flora for the county now stands at 82 full species, excluding those which are probably extinct. (This compares with totals of 75 for Suffolk & 45 for Cambridgeshire).

References

New Vice County Records and Amendments to the Census Catalogue. *Bulletin of the British Bryological Society*: 1982 (**40**); 1983 (**42**); 1984 (**44**); 1985 (**46**); 1986 (**48**); 1987 (**50**); 1988 (**52**); 1989 (**54**); 1990 (**56**); 1991 (**58**); 1992 (**60**).

CORLEY, M.F.V., & HILL, M.O. 1981. *Distribution of Bryophytes in the British Isles. A Census Catalogue of their Occurence in Vice-Counties*. Cardiff: British Bryological Society.

PETCH, C.P., & SWANN, E.L. 1968 *Flora of Norfolk*. Norwich: Jarrold & Sons.

SMITH, A.J.E. 1990 *The Liverworts of Britain & Ireland*. Cambridge: Cambridge University Press.

STEVENSON, C.R. 1992 A Checklist of the Mosses of Norfolk. *Trans. Norfolk Norwich Nat. Soc.* **29** (3), 189 - 195.

SWANN, E.L. 1975 *Supplement to the Flora of Norfolk*. Norwich: F. Crowe & Sons.

SWANN, E.L. 1982 Norfolk Bryophytes Today. *J. Bryol.* **12** (1), 77 - 112.

Aneura pinguis (L.) Dum
(*Anthoceros agrestis* Paton)
Barbilophozia attenuata (Mart.) Loeske
B. barbata (Schmid ex Schreb.) Loeske .....(28)
B. floerkei (Web. & Mohr) Loeske.....(*) (28)
B. hatcheri (Evans) Loeske .....(28)
Blasia pusilla L.
Calypogeia arguta Nees & Mont.
C. fissa (L.) Raddi
C. muelleriana (Schiffn) K. Müll
C. sphagnicola (H. Arn. & J. Perss.) Warnst. & Loeske.....(28)
Cephalozia bicuspidata var. *bicuspidata* (L.) Dum.
var. *lammersiana* (Hüb.) Breidl.

C. connivens (Dicks.) Lindb.
C. macrostachya var. *macrostachya* Kaal.
C. pleniceps (Aust.) Lindb. .....(27)
Cephaloziella elachista (Jack ex Gott. & Rabenh.) .....(27)
C. hampeana (Nees) Schiffn.
C. rubella (Nees) Warnst. .....(28)
C. starkeana = *C. divaricata* (Sm.) Schiffn.
Chiloscyphus pallescens = *C. polyanthos* var. *pallescens* (Ehrh. ex Hoffm.) Hartm.
Cladopodiella fluitans (Nees) Buch
C. francisci (Hook.) Joerg
Conocephalum conicum (L.) Underw.
Cryptothallus mirabilis Malmb. .....(28)
Diplophyllum albicans (L.) Dum.
D. obtusifolium (Wahlenb.) Dum.
Fossombronia foveolata Lindb.
F. pusilla (L.) Nees
F. wondraczekii (Corda) Dum. .....(28)
Frullania dilatata (L.) Dum.
F. tamarisci (L.) Dum. .....(28)
Gymnocolea inflata (Huds.) Dum.
Leiocolea badensis (Gott.) Joerg. .....(*) (28)
L. rutheana (Limpr.) K. Müll.
L. turbinata (Raddi) Buch.
Lepidozia reptans (L.) Dum.
L. setacea = *Kurzia pauciflora* (Dicks.) Grolle
Lophocolea bidentata var *bidentata* (L.) Dum.
L. cuspidata = *L. bidentata* var *rivularis* (Raddi) Warnst.
L. heterophylla (Schrad.) Dum.
Lophozia bicrenata (Schrad. ex Hoffm.) Dum.
L. capitata (Hook.) Macoun .....(*) (28)
L. excisa (Dicks.) Dum.
L. incisa (Schrad.) Dum.
(*L. porphyroleuca* = *L. longiflora* (Nees) Schiffn.) .....(27)
L. ventricosa var. *ventricosa* (Dicks.) Dum. .....(28)
Lunularia cruciata (L.) Dum. ex Lindb.
Marchantia polymorpha L.
Metzgeria fruticulosa (Dicks.) Evans
M. furcata (L.) Dum.
Moerckia flotoviana = *M. hibernica* (Hook.) Gott.
Mylia anomala (Hook.) S.F. Gray
(*Nardia geoscyphus* (De Not.) Lindb.) .....(28)
N. scalaris S.F. Gray
Odontoschisma sphagni (Dicks.) Dum.
Pellia endiviifolia (Dicks.) Dum.
P. epiphylla (L.) Corda
P. neesiana (Gott.) Limpr. .....(*) (27)
Petallophyllum ralfsii (Wils.) Nees & Gott. .....(28)
Plagiochila asplenioides (L. emend. Tayl.) Dum.
Plectocolea hyalina = *Jungermannia hyalina* Lyell .....(27)
Porella platyphylla (L.) Pfeiff.
Pressia quadrata (Scop.) Nees
Ptilidium ciliare (L.) Hampe
P. pulcherrimum (Web.) Vanio
Radula complanata (L.) Dum.
Reboulia hemisphaerica (L.) Raddi .....(27)
Riccardia incurvata Lindb. .....(*) (28)
R. latifrons (Lindb.) Lindb.
R. multifida (L.) S.F. Grey
R. sinuata = *R. chamedryfolia* (With.) Grolle.
Riccia cavernosa Hoffm. emend. Raddi .....(28)
R. fluitans L. emend. Lorbeer

R. glauca L.
R. rhenana Lorbeer.....(28)
R. sorocarpa Bisch.
R. warnstorfii = *R. subbifurca* Warnst. ex Crozals .....(28)
Ricciocarpos natans (L.) Corda
Scapania compacta (H. Roth) Dum.
S. irrigua (Nees) Nees
S. nemorea (L.) Grolle .....(27)
S. undulata (L.) Dum. .....(27)
Solenostoma crenulatum = *Jungermannia gracillima* Sm.
Sphaerocarpos michelii Bellardi
S. texanus Aust. .....(27)
(*Tritomaria exsectiformis* (Breidl.) Loeske) .....(27)

DATES OF PUBLICATION OF THE *TRANSACTIONS OF THE NORFOLK AND NORWICH NATURALISTS' SOCIETY*, 1870-1992.

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The Norfolk and Norwich Naturalists' Society held its first meeting on 27 April 1869. One of the objectives of the new society (listed in the first volume of its *Transactions*) was 'The publication of Papers on Natural History, contributed to the Society, especially such as relate to the County of Norfolk.' The aims of the Society have changed very little over the years and 'the publication of papers on natural history, especially those related to the county of Norfolk' is still one of the Society's principal objectives (see back cover of this issue).

The first part of the *Transactions of the Norfolk and Norwich Naturalists' Society* was published in 1870 and the journal has appeared more or less regularly ever since. Throughout most of the Society's history the *Transactions* was its only serial publication and one part was usually published each year. Since the introduction of the annual bird report in 1954 (see below) two parts have generally been issued each year.

In 1923 a paper entitled 'Wild bird protection in Norfolk in 1922' appeared in the *Transactions*, the first report of the Society's Wild Birds Protection Committee. The Society included an annual report of the Committee's work in the *Transactions* until 1933 (for 1932). Responsibility for funding wild bird protection was transferred from the Society to the Norfolk Naturalists Trust, who published annual reports from 1934 until 1953 (for 1933-1952).

In 1954 the Norfolk Bird Report for 1953 was jointly published by the Trust and the Society as a supplement to the *Transactions*. Publication of an annual bird report has continued since then. Initially the bird report formed a whole part of the *Transactions* but after a few years it was joined by the mammal report. Since 1983 the bird report has been published by the Society in association with the Norfolk Ornithologists Association.

Between 1953 and 1959 the Society circulated six mammal newsletters (with various titles). In 1960 the Norfolk Mammal Report for 1959 was pub-

lished in the *Transactions* and a mammal report has usually appeared annually ever since.

The table below lists all parts of the *Transactions* that have been published up until the end of 1992 and includes supplements and title pages for complete volumes.

Volume	Part[1]	For[2]	Date[3]	Pagination[4]	Subject[5]
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	[4]	1872-73	1873	1-120	
	[5]	1873-74	1874	1-85	
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	2	1990	Aug 1991	81-168	B M
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[1] Supplements (Suppl.) and title pages (TP) for completed volumes have been included here as well as parts. The five parts that made up volume 1 were issued without part numbers. Numbers have been assigned to these parts in order to maintain consistancy within the list and are indicated by square brackets. Material that was not originally referred to as a supplement but was nevertheless separately paginated has been treated as a supplement and indicated by square brackets. Volume 24 part 6 was incorrectly numbered volume 25 part 1 and volume 25 part 4 was incorrectly numbered volume 25 part 3.

[2] Every part included in the first 17 volumes of the *Transactions* was issued 'for' a specified

year. Since volume 18 part 1 bird and mammal reports have been issued for specified years whereas parts containing miscellaneous papers have not.

[3] Publication dates have been taken from the covers, title pages or contents pages of individual parts. Several parts and the title pages of a few volumes were issued without publication dates. The probable publication dates of the undated parts have been inferred and are indicated by square brackets. The publication dates of a few title pages that could not be ascertained are indicated by ND in square brackets.

[4] Jumps in pagination are the result of blank pages at the ends of parts or inconsistancies in the treatment of prelims and advertisements. In some cases they were included in the pagination, in other cases they were omitted.

[5] No subjects have been indicated for those parts that consisted of miscellaneous papers.

A Botany
B Norfolk Bird Report
C Catalogue of the Norfolk and Norwich Naturalists' Society library
D The Diptera of Norfolk and Suffolk
F Mycology
G The Geology of Norfolk
I Index to the *Transactions of the Norfolk and Norwich Naturalists' Society*, volumes 1 - 8
L Fauna and flora of Norfolk. Part V. Lepidoptera
M Norfolk Mammal Report
P President's address

THE NATIVE BLACK POPLAR (*POPULUS NIGRA* SUBSPECIES *BETULIFOLIA*) IN NORFOLK

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Introduction

During 1984 I became acquainted with the native Black Poplar in the Woodbridge area. I realised then that some trees growing at Larling, Norfolk were also the native species. Peter Lambley put me in touch with Edgar Milne-Redhead, the national authority on Black Poplar in Britain, who kindly sent me his Norfolk records. Since then I have been able to check the continued existence of some, investigate reports of others and add a few to the list myself.

During the spring of 1992, with the help of a grant from the Farming and Wildlife Advisory Group, I was able to visit all the recorded trees in Norfolk to obtain reproductive material and took the opportunity to gain as much information as I could in the brief time available. This paper combines the 1992 results with earlier records.

The identification of the native Black Poplar

Most Poplars in Norfolk are hybrids between the European Black Poplar and the American Eastern Cottonwood (*Populus deltoides* Marsh) which have been produced since the mid 18th century. The hybrids are given the overall name of *Populus x canadensis*. Crosses and backcrosses have produced a bewildering number of clones which have been introduced into Britain at various times since the late 18th century. Our native tree can be most easily identified when it is more than fifty years old. There is some variation in different parts of the coun-

try. For example, in places, the massive lower branches do not develop and in others the twigs are glabrous. The following characters should be combined to make a positive identification..

1. The mature tree is massive; up to 30m. high and 2m. diameter at 1.3m.above ground level. The trunk often leans (Rackham 1986).
2. The lower branches arch downward very strongly to the ground if not cut or browsed.
3. The grey-brown bark is deeply fissured and heavily bossed in older trees.
4. Upper branches are ascending, the tree developing a wide spreading crown.
5. The pale yellow twigs are sticky towards the tips. They are finely downy when young, as are the leaf stalks. This feature is missing in the European *Populus nigra var. nigra* L.
6. The leaf is rhombic ovate with cuneate or truncate base and normally lacking basal glands. The marginal teeth are not normally hooked.
7. The male catkins are red and very attractive and the female green, followed by white downy seed in June.

Many Norfolk trees are now reduced by age and storm damage and no female trees are known to survive in the county.

Historic references to Black Poplar in Norfolk

It may appear somewhat surprising that one of our largest native trees has been overlooked by botanists and foresters alike from the early years of the 19th century to the mid 20th century. It was not until E. Milne-Redhead devoted himself to recording the known British distribution during the 1970,s that its fortunes revived. A survey of the old published records, though not great in number does support the pattern of distribution noted in the recent survey. The earliest reference found was in a letter from Sir Thomas Browne to John Evelyn informing him of a tree at Sir William Gaudies gate at West Harling not much inferior to the Linden at Deopham which blew down in 1659 . The Deopham Linden was eight and a half yards around the narrowest part of the trunk and thirty yards high.

In his *Eastern Arboretum* (Grigor 1841), James Grigor records a number of poplars among his notable trees. Mr. John Wright had some magnificent poplars in his garden one of which, on the edge of the River Wensum was considered the finest specimen of the sort in Norwich. Four feet above ground it was 16 feet in circumference. The trunk was 36 feet to the lower branches and the overall height 80 feet. Across the Wensum, in the Rev. Frost's garden there were some tolerable specimens of Black Poplar growing by the side of the River . There is an illustration of one in Chapelfield which appears to be a native tree with the lower branches removed. Near Cringleford, Grigor records that in that part of the Yare valley 'The trees have arrived in tolerable perfection, especially the Poplar and Walnut tribe'. At Framingham, a handsome poplar tree stands by the roadside having a stem of 30 feet, and at Long Stratton, in the centre of the village were a few limes and poplars unmercifully shorn of their side branches yet rejoicing in crowns of green . Passing mention is made of a stately poplar, 10 feet in circumference, on the lawn of a house in Swaffham. At Narborough, on the roadside in the front of Mr. Everett's mills, was a poplar 10 feet 10 inches in circumference. At Northwold were fine poplars in the grounds of Mr. John

Carter. In Thetford, at Place Farm, were 'several magnificent Black Poplars proving that at one time this spot had been of greater note.' At Weeting Hall, 'its greatest ornaments are of the Black Poplar', and at Riddlesworth Hall was a Black Poplar 15 feet in circumference one foot from the ground.

Bustin (1940) reports that 'In Grigor, the Black Poplar was growing on the north side of Chapelfield. This was the grandest tree in the field until some twenty years ago when it was dispossessed of its huge boughs. The trunk was six feet in diameter when it was cut down in 1932.' If this was the same tree as that illustrated in Grigor the branches removed must have been the upper crown as the lower ones had been lopped by 1841. This would be consistent with the gradual decline of the tree. Cuttings from this tree may have provided material for trees now in Earlham Cemetery which appear to be about 60 years old.

Following Grigor, the Reverend Kirby Trimmer (1866) records Black Poplar as 'not infrequent by river banks and moist places, Honingham, Oxnead, Billingford and Cossey.' These fit well with current records on the Wensum and Yare above Norwich, except for Oxnead which is the only recorded occurrence on the Bure system.

Nicholson (1914) states that Black Poplar is indigenous in south and east England and rather common on river banks. The first statement is correct, but by that date it is likely that hybrid plantings were causing confusion.

Petch and Swann (1968) describe Black Poplar as 'native, frequent, streamsides.' This is corrected in Swann (1975) that it is frequent is not correct. It should refer to the many hybrids in such habitats. Native trees at Shimpling, Frenze Hall, Whitlingham and Geldeston are recorded; all but the last named are now gone.

E.A. Ellis had some fine photographs of the Whitlingham trees in his collection, now housed at the Castle Museum. In his daily notes in the Eastern Daily Press, he recorded on one occasion that he visited trees at Geldeston. One had fallen and was in the last stages of decay. Of the other two he mentions, one was blown down in the hurricane of 1987, but is regenerating.

Summary of previous records

Date	Authority	Location	River System	Notes
1663	Browne	West Harling	Thet	A tree still in village
1841	Grigor	Norwich	Wensum/Yare	
1841	Grigor	St. Faith's Lane Norwich	Wensum	
1841	Grigor	Thorpe	Yare	No current records
1841	Grigor	Hethersett	Yare	
1841	Grigor	Framingham	Chet	
1841	Grigor	Long Stratton	Tas	
1841	Grigor	Swaffham	-	
1841	Grigor	Narborough	Nar	
1841	Grigor	Northwold	Wissey	A tree still in village.
1841	Grigor	Thetford	Little Ouse	No current records
1841	Grigor	Weeting	Little Ouse	A tree still in village.
1841	Grigor	Riddlesworth	Little Ouse	No current record
1866	Trimmer	Honingham	Tud	No current records
1866	Trimmer	Morton	Wensum	No current records
1866	Trimmer	Billingford	Wensum	no current records
1866	Trimmer	Cossey	Wensum	Probably trees recorded at Drayton
1866	Trimmer	Oxnead	Bure	No current records

1940	Baston	Chapelfield	Wensum	?Recorded by Grigor
1975	Petch	Shimpling	Waveney	Blown
1975	Petch	Frenze	Waveney	Blown
1975	Petch	Whitlingham	Yare	Cut down in 1974
1975	Petch	Geldeston	Waveney	One still present

It is significant that all the old records with the exception of that at Swaffham correspond well with the current survey.

Discussion

Though Rackham (1986) suggests that the survival of *Populus nigra* to the present time is a last shadow of the wildwood , very few of the trees remaining were not planted by man. An association with farms is common, possibly to produce a quick source of stakes. It may be that trees in the Wymondham area were associated with the turnery and spoon making carried out there until around 1800. As at Long Stratton (Trimmer, 1866) many trees appear to have been shorn or shredded for firewood, a common Medieval practice. Selby (1942) mentions the use of the wood for bowls, sabot, small rafters, railings and basket making, but says that it is almost useless for fuel. The bark can be used for tanning and for fishing net floats.

The curved lower branches were used in the building of 'cruck' buildings (Rackham, 1986) and may have been the origin of this building type. There are no local examples. The wood lasts well when submerged; a hollowed trunk has been found as a well lining in Viking York (Hall, 1984) and arrows recovered from the Mary Rose at Portsmouth were of Black Poplar which still grows in the town (McKee, 1982)

Type and location of Norfolk Trees

During the survey, notes were made on each tree, some of these had to be subjective as pollards turn into standard trees, ponds are filled and hedgerows removed, but the following figures are basically accurate.

Type of tree	
Old live trees i.e. 150 years+	47
Old dead trees	8
Trees lost since 1970	14
Locations not traced	2

The situation is continually changing. The tree at Binham blew down two days before this note was written (January 1993), but the numbers of dead, removed or untraceable trees 24, compared with 47 living specimens, indicates how close we are to losing this species in Norfolk. A tree at South Lopham could be described as 'coppiced' and there is a maintained pollard in a garden at Hethersett.

Natural regeneration was occurring from damaged roots on six sites and from fallen branches at three more. Three trees had grown from the fallen trunks of their ancestor.

A number of owners have taken and distributed cuttings, these were not counted in the survey. The only major planting is at Whitwell, where cuttings were taken more than forty years ago and planted in a hedgerow when an

ancient tree was removed. From these, further cuttings have been taken recently to form an avenue and group in a wood

An assessment was made of each site, as some trees occur in more than one category the total is more than 100%.

On a farm (Part of the buildings and yard complex	31 %
By a pond	25 %
In a hedgerow	38 %
In a field	7 %
In a river or stream valley	30 %

Even though 70% of sites were away from the river, 25% were by ponds indicating that those planting the trees believed that they preferred a waterside situation.

Naturally regenerated trees

The majority of trees in the survey were planted by man. Trees which were self sown would have occurred along the river valleys, as *P.deltoides* still does in North America (Rackham,1986). Five trees may fit this category. In prehistoric times, Black Poplar was a tree of unstable gravely flood plains of slow flowing rivers, so must have been much more widespread in Norfolk in the past. If any of the trees still extant in the county are directly descended from those of prehistory, those at Geldeston, Broome and Drayton appear to be the most likely candidates. This should not exclude the possibility of there being others growing near the Waveney, Little Ouse, Thet, Wissey, Nar, Yare or Wensum. Some of these may grow within what would formerly have been the flood plain of the upper reaches of the streams before canalisation. Strangely the only extant record for Broadland is near the Thurne at Ludham, and there is the one historical record from the Bure at Oxnead. It would appear that *Populus nigra* ssp. *betulifolia* prefers a gravely substrate to waterlogged peat.

Black Poplar, the future

The absence of female trees known in the county and the frequency of hybrids means that it is virtually impossible to ensure crosses from native material even under controlled laboratory conditions. The only viable solution to maintaining a population of Black Poplar in the county is by the taking and distribution of cuttings. Natural regeneration from seed in Britain becomes less possible each year as drainage of the river valleys has improved. Regrowth from fallen trees or damaged roots is relatively rare. The most impressive regeneration taking place locally at the present time, is from an ancient tree in the Military Training Area at Sturston. This has fallen apart, and is now producing about a dozen fine new trees.

In the spring of 1992 about 1000 cuttings were taken from Norfolk Black Poplars. These are being grown at Easton College and will be distributed by FWAG and County and District Foresters, when sufficiently grown, in small numbers back to the general location from which they came. A stool bed for cuttings will also be established.

Acknowledgements

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Fig. 1 Tetrad distribution of Populus nigra ssp. betulifolia in Norfolk. Closed circles represent trees seen during the present survey. Open circles represent earlier sites, where the species is no longer present

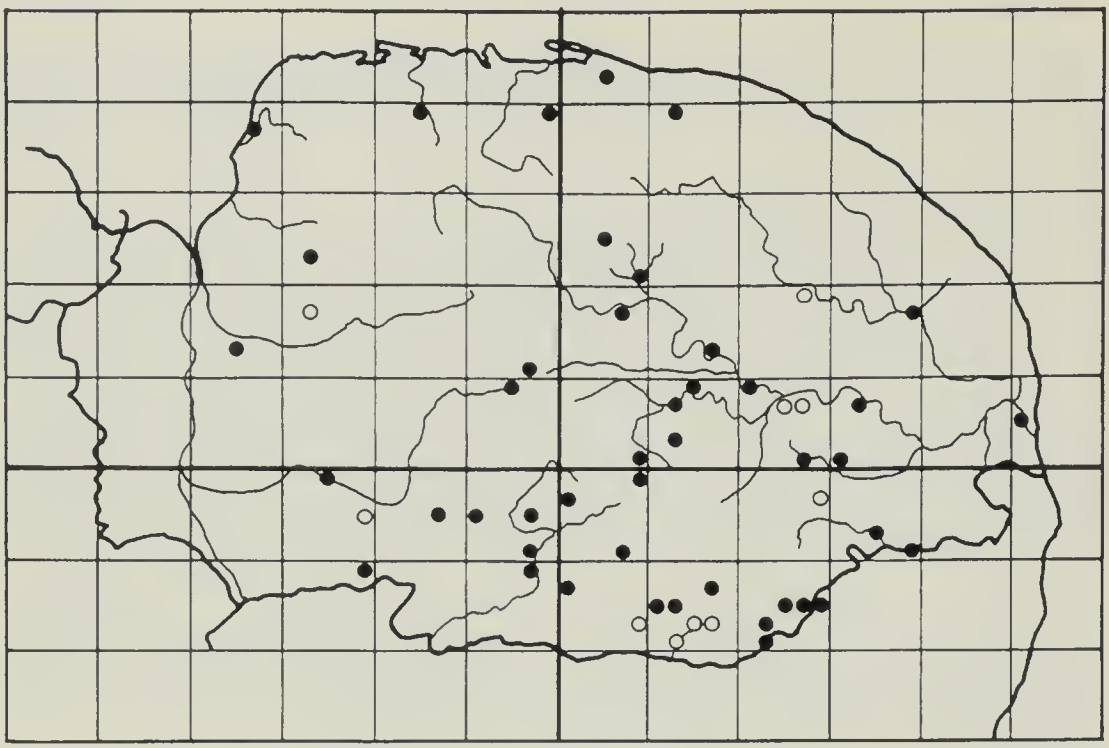

Table 1 Present distribution of trees

Map reference	Location	Brief notes
52/751980	Northwold	By stream, partially blown down but re-established.
52/782881	Weeting	Roadside hedge
52/977899	Larling	Edge of fen woodland. All old trees dead. One young tree from roots 20m. One risen from embedded branch 6m
52/977905	Larling	2 by pond
52/962946	Breckles	Middle aged tree
52/900951	Tottington	One live, one now dead. Hedge and ditch side.
52/875950	Sturston	2 trees originally one disintegrated but new trees rising from fallen branches
53/992390	Binham	One old tree blown down Feb.'93,4 new trees rising from roots 20m. to the east.
53/852382	North Creake	Old tree gone. New tree rising from roots. Cuttings distributed locally.
53/672367	Heacham	Old tree in hedge.
53/722235	Congham	Old tree in hedge
53/649128	Setchley	2 pollard trees in ditch by field.
53/944095	Bradenham	one old tree in hedge by farm. Survivor of a number.

53/953094	Daffy Green	2 trees by farm pond.
53/961118	Scarning	Not found in 1992/3
53/738170	East Walton	Felled 1991. Tree ring count 141 years. Roadside hedge.
62/095997	Suton	Ditch/hedge nr. farm. Single stem from short Pollard.
62/050802	South Lopham	Roadside hedge coppiced.
62/113848	Winfarthing	Hedge by stream.
62/133853	Gissing	Pollard, hedge by road.
62/225806	Needham	4 trunks on short pollard. 2 more trunks rising from ground level.
62/225837	Starston	Farmyard/pond. 2 young trees from cuttings on either side of original.
62/251842	Harleston	Not found 92/93.
62/281855	Wortwell	Old Pollard
62/279853	Wortwell	Young trees.
62/168864	Tivetshall	By ditch near moat.
62/298963	Kirkstead	Blown down 1987, no regeneration.
62/080822	Bressingham	Snapped off at 2 feet, regeneration unlikely
62/169828	Dickleborough	felled and roots extracted.
62/20-89-	Tyrells Wood	Not found '93.
62/063916	Old Buckenham	Village green
62/390918	Geldeston	1. Flood plain, old tree. 2. Blown 'about 20 years ago', 2 branches still growing and new tree arising from roots.
62/137805	Frenze	Not found, probably gone.
62/158825	Shimpling	Blown down, 'some years past'. No regeneration.
62/004871	East Harling	Hedge by road.
62/019963	Great Ellingham	Originally blown 1987, 3 new trees rising. One pollarded for cuttings.
62/012978	Great Ellingham	Bow Street. By pond in farm garden. Pollarded 1992
62/343923	Broome	By streamside. Mature tree.
63/043428	Wiveton	2 trees, farm garden.
63/122384	Baconsthorpe	Woodland by lake.
63/049246	Foulsham	Roadside/pond (filled in)
63/069162	Lyng	Primrose Green, field nr. farm.
63/173123	Drayton	Flood plain. 2 old trees both rising from fallen trees. One cut off stump on ditchside coppicing c. 50m. from one tree.
63/156087	Bawburgh	7m. of broken-off trunk, shooting well.
63/207088	Norwich	Earlham cemetery, 6 trees in middle age.
63/219096	Norwich	Old Palace Road, nr. Wensum.
63/388177	Ludham	Blown down some years ago.
63/389176	Ludham	5 pollards opposite another farm, one dead. Identity needs checking.
63/505057	Bradwell	2 trees in hedge on edge of marshes.
63/136066	Great Melton	Old tree in park
63/272015	Poringland	By pond
63/086011	Wicklewood	Two short pollards by pond.
63/132032	Wymondham	Two middle-aged trees now in gardens.
63/088213	Whitwell	Avenue of young trees, cuttings from tree felled in 1950, not seen.
63/242070	Trowse	Felled.
63/269079	Whitlingham	By Yare, one tree each sex, felled 1974.
63/21-19	Horstead	By Bure, now gone.
63/312008	Bergh Apton	Old trees in hedge.

References

KEYNES, G. (ed.) 1946 *Letters of Sir Thomas Browne* Faber

BUSTIN, W. 1940 *Some noted Norfolk Trees*. Unpublished Ms. Norwich City Library.

ELLIS, E.A. 1946-86 In the Countryside. *Eastern Daily Press*.

HALL, R. 1984 *The Viking Dig. The Excavations at York.* The Bodley Head.
JOBLING, J. 1990 *Poplars for Wood Production and Amenity.* Forestry Commission Bulletin no. 92.
McKEE, A. 1982 *How we found the Mary Rose.* Souvenir Press.
NICHOLSON, W. 1914 *Flora of Norfolk.*
PETCH, C.P. & SWANN, E.L. 1968 *Flora of Norfolk.* Jarrolds.
SWANN, E.L. 1975 *Supplement to the Flora of Norfolk.* Crowe & Sons, Norwich
RACKHAM, O. 1986 *A History of the British Countryside.* Dent.
SELBY, P.J. 1842 *A History of British Forest Trees Indigenous and Introduced.* John Van Voorst, London.
TRIMMER, K. 1866 *Flora of Norfolk.*

THE EFFECT OF PINE AFFORESTATION ON THE LEPIDOPTERA OF BRECKLAND

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Abstract

Breckland is of international importance for its calcareous heath that supports specialised lepidoptera.

Breckland was described as "an almost treeless waste" until 18th century planting of shelter belts and coverts. Pine afforestation by the Forestry Commission began in 1922. The majority of land planted was grassland, heather-land and the true brecks, which was the preferred lepidopterous habitat of several species unique in Britain.

The lepidopterous fauna of the area was well known by the end of the last century. Comparison with the present day fauna reveals the extinction of key species, with others much declined or endangered. This paper examines the extent to which lepidoptera loss can be attributed to pine afforestation.

The secondary habitat provided by Scots pine plantation has encouraged a multitude of common lepidoptera of undemanding life cycle, but the change to Corsican pine and demand for increased timber yield will offer fewer opportunities for them.

Introduction

Lepidoptera, along with birds and flowering plants, are among the few major wildlife groups of the Breck that have been extensively studied since last century. They offer opportunity to trace population change as the character of habitat has altered from open heath to coniferous forest.

Four moths, unique in Britain to the Breck ecosystem, are accepted as critical indicators of species that had prospered in this special environment. They, and others discussed in this study, are described as key because of their success here while absent from, or restricted, elsewhere in Britain. They all feature in lists of national scarcity made in 1984 by Nature Conservancy Council; namely - Red Data Book categories 1, 2, and 3, Notable `a' and Notable `b' (Shirt 1987). To these have been added non-listed species that have declined in the Forest

Park since 1984 but which still succeed in the surrounding Breck.

In this paper the availability within the Breck, before afforestation, of the specialised habitats required by their macrolepidoptera is compared with what is to be found after 70 years under pine plantation. The structure of the forest is reviewed as a habitat of resident lepidoptera and an assessment is given of their response to the sequence of forest operations.

Breckland before afforestation

For most of historical time Breckland was devoid of trees. W. G. Clarke (1925) has well summarised the impressions of bleakness, open-ness, and near-desert conditions recorded by travellers of the 17th and 18th centuries. Planting of Scots pine hedges and belts and small copses began just before the time of the enclosures, which here date from 1801. Further planting was done by larger estates in the 19th century. By the time of the first World War the Breck landscape still offered open spaces, heathland and some shifting sands, with woodlands clustered around estate centres.

The land acquired for pine afforestation, by the Forestry Commission, was largely grass heath, heather heath and the true brecks - land intermittently put under temporary cultivation and then left fallow. Much had been intensively warrened for rabbits since the 15th century. Within this area were several wetlands concentrated along the valleys of the rivers Wissey, Little Ouse and Lark. There was little acquisition of woodland, and none of ancient woodland sites. The total area acquired was about one fifth of the overall area of Breckland.

There is recorded history, between 1909 and 1990, of the change of the Breck habitat at one important site that may be taken as indicative of much of the area. In 1909 W. G. Clarke (1910) recorded "a few hundred yards east of Cranwich Heath, on both sides of the road between there and Mundford, *Silene otites* was growing almost as thickly as a hay crop". In 1950 the key Breck lepidoptera *Hadena irregularis*, *Emmelia trabealis*, and *Scopula rubiginata* were still along these road verges and on the adjacent Forestry Commission fallow site, now leased to the Ministry of Defence (Haggett, 1951b, & 1952). By 1990 these three moths were absent. The ground on the south side of the road to Mundford was high forest and to the north agricultural. The *Silene otites* that was so dense in 1909 for some 2 kilometers, and which still occupied about half a hectare in 1950 was, by 1990, reduced to few scattered plants standing on a matter of square meters.

The Lepidoptera before afforestation

Three habitats dominated before afforestation - calcareous heath, acid heath and wetlands, although the latter occupied only a fraction of the total Breck area. Each had their own specialised moths in addition to a much greater number of species tolerant of a wider range of site types. There were also species attached to broadleaved trees and shrubs that had occupied the secondary woodlands and spinneys, and the hedgerows.

The Breck had long been known for its moths resident nowhere else in Britain and which were well distributed through the area in discrete populations or colonies. It was also renowned for a number of moths that occur elsewhere on coastal sand-dunes, while a further group was associated with chalk downland in

other parts of the country. Moths of the calcareous heath appear to have evolved an existence dependent upon sparse ground cover where they receive maximum heat from the sun, and if that habitat were to grow scarce so their numbers would dwindle. Most thrived on abandoned agricultural land where they enjoyed a mixed flower diet, and their presence on roadside verges was commonplace. The fauna was well known and described by county recorders. The following are the principal species of ecological significance, presented in declining order of Nature Conservancy Council ranking (Hadley, 1984 and Shirt, 1987).

From calcareous heath: *Hadena irregularis*, *Emmelia trabealis*; *Tyta luctuosa*; *Scopula rubiginata*, *Lithostege griseata*, *Heliothis viriplaca*; *Phibalapteryx virgata*; *Adscita statices*, *Eupithecia subumbrata*, *Sideridis albicolon*, *Heliophobus reticulata*, *Apamea sublustris*; *Erynnis tages*.

From acid heath: *Noctua orbona*; *Plebejus argus*, *Hipparchus semele*, *Eupithecia absinthiata* f.*goossensiata*, *Chesias rufata*, *Arctia villica*, *Diacrisia sannio*, *Xestia agathina*, *Stilbia anomala*.

From wetlands: *Perizoma sagitatta*; *Senta flammea*, *Archanara algae*; *Sesia apiformis*, *Idaea muricata*, *Eupithecia trisignaria*, *Anticollix sparsata*, *Simyra albovenosa*, *Macrochilo cribrumalis*; *Clostera pigra*, *Archanara geminipuncta*, *Archanara dissoluta*, *Chilodes maritimus*, *Deltote uncula*, *Earias clorana*.

Key species from more than one habitat type: *Sesia bembiciformis*, *Eupithecia insigniata*, *Hemaris fuciformis*, *Photedes fluxa*; *Rheumaptera cervinalis*, *Philereme vetulata*, *Eupithecia dodoneata*, *Xestia rhomboidea*.

A key moth associated with conifers was *Eupithecia indigata*, and there were two broadleaved woodland species *Apoda limacodes* and *Drepana cultraria*.

Thetford Forest structure today

A policy of intensive land use for cropping left little of the total forest area under other forms of land use. Tables 1-5 are from Forestry Commission data.

Elaboration of terms used in Table 1

Lowgrade broadleaved - is used to indicate growth of inferior form and species that, while in time would produce some utilisable timber, would remain inferior to plantations of fully stocked, well-formed stems. Often of natural origin but can include planted stands of poor genetic origin.Plantation Scrub -includes islands of broadleaves, of both timber potential and non-timber producing species, that are situated within stands of conifer timber and are too small an area to be separated on stockmaps.

Retained Scrub - was introduced to describe areas of non-timber species that were to be kept untreated to fulfill an amenity or conservation benefit. Previously such areas had been classified as available for planting, and they constituted a target under the name of plantable land in hand.

Blank - is a measure of understocking of productive plantations. It can comprise rock outcrops, water surfaces, old military hut bases, but at Thetford commonly represented crop failure and invasion by native resident shrubs and bushes.

These categories, along with recreation sites, occupy but a fraction of the total Thetford Forest area, but they provide a favourable environment for a wide range of non-demanding species of lepidoptera that greatly expand habitat

potential. These terms no longer appear on data summaries so their relevance for wildlife is lost. They mostly have their origins in imperfect sylviculture, or past inability to coniferise difficult sites, and can be said to be an accidental wildlife benefit. These habitats would be expected to diminish with increased technology of future forest operations.

Open Space

At, and following, canopy closure prime breck lepidoptera habitats virtually disappeared from plantations, but open spaces persisted in the total forest area until post second world war. These spaces took the form of land adjoining large agricultural lettings, Forest Worker holdings, fire traces (land kept bare to contain fire outbreak) - especially alongside the railway, together with scattered miscellaneous land not considered worthy of planting. All such land vanished under new economic policy so that from 1960 the three prime habitats of grass-heath, heather-heath and true breck reduced and eventually ceased to exist within the forest area. Their demise coincided with the extinction of key lepidoptera, and the decline of others.

Forest Roads and Rides

The significance to wildlife of roads and rides in Thetford Forest Park cannot be overstated. They constitute the largest part of the total open space within the forest and provide a reservoir of plant communities that would disappear as the tree canopy closed in plantation. A total of some 5% of all land is so accounted for, and it links all parts of the blocks. The forest is well served by the network so that there is no plantation area larger than 20 hectares that is not bounded by a permanent ride on one side, or more usually on all sides.

However, few of these roads and rides occupy a width greater than tree height at maturity, so as each restocked crop ages the roads and rides become side-shaded, with a great many totally under canopy and supporting solely coarse, moist grass.

The forest as a lepidopterous habitat

The individual character of plantation habitat of the forest is dependent upon the forest operations at each age of the crop. Clearfelled and newly stocked land up to 5 years offer the most open conditions for mobile flowering plants and so for generalised butterflies and moths. Increasing canopy closure can still allow inter-row re-growth to present a useful variety of shrub and low woody growth foodplants. The thicket stage, from 11 to 20 years, presents a higher, uniform canopy which is limited to conifer feeders, but it can contain broadleaved intrusion, gorse and broom. Thereafter heavy selective and line thinnings admit ground and shrub flora increasingly with age, until by 40 years significant cover is achieved on responsive sites. The longer the stand is then retained the greater its potential for lepidoptera that are woodland and general feeders.

The presence of so many lepidoptera common to broadleaved woodland and general habitat is in large measure due to the widespread distribution within forest crops of their common foodplants, be these ground or shrub or tree. This is due to two principal factors: firstly previous use of Scots pine as the main crop; and secondly to past establishment methods. Both are closely inter-related. Scots pine is, at Thetford, a thin- and small-crowned conifer that has allowed

much broadleaved invasion; in forest crop terms it has commonly been understocked and the gaps have been occupied by woody growth that supports a far greater variety of Lepidoptera than the pine. Broadleaved trees and shrubs have also freely colonised even fully stocked stands when past middle age under the light and open pine canopy. Further scope for intrusive species arose from conifer heart rot fungus *Fomes annosus* attack and wind-blow gaps. Broadleaves commonly found in all these situations are oak, birch, sallow and hawthorn and these are the top four larval foodplants (Appendix 3). Amongst ground flora often associated with broadleaves, and gaps in pine crops, are *Lamium* spp., *Plantago* spp., *Rumex* spp., *Stellaria* spp., *Taraxacum officinale* and Gramineae, which are those plants next most frequently used by the Lepidoptera for larval food. But the forest environment, while housing a great number of generalised Lepidoptera species, supports specialised habitats only where adjacent to non-plantation land, or in some cases where adjoining broad, permanent rides. In particular the plantation environment fails to support those key Breckland Lepidoptera of calcareous heath or even acid heath. Only the wetland species have survived intact because very little conifer planting, and only limited poplar planting, was done on that habitat type.

Restocking sites have failed to produce the key species since fellings began in the 1970's, and the open phase so favourable to generalised species has proved unattractive to the more sensitive, offering a parallel situation to that of the Stone Curlew.

Present day Lepidoptera of Thetford Forest

491 species of macrolepidoptera are known today to be resident within the Thetford Forest Park area, a figure that compares well with any similar sized territory in Great Britain. The habitat types within the Forest Park each support their own range of species with a further group found in more than one of the different habitats.

The broadleaved forest species are common to a range of woodland types from emergent and immature to long established secondary woodlands, and exclude species that are associated with ancient woodlands of the Midlands and South East England. The heath and wetland species include moths that are very restricted in their British distribution. Generalised species (those from more than one habitat) are typical of lowland sites that are not under extremely hostile land use. Species of broadleaved forest and those of this generalised group may be found anywhere within the Forest Park except in the densest, thicket stages of pure conifer.

It is the species of the two heath habitats that are so restricted in numbers, their foodplants and their breeding sites. They are clearly linked to an open space requirement and plant communities free from coarse and woody plant invasion. By contrast the wetlands have largely remained intact and while their moths are closely site-restricted they show no decline. Within the broader picture of the decline of heath species and populations, and the prosperity of woodland and generalised species, there is the more dramatic story of new arrivals tempered by losses through extinction and reduced status to "endangered".

The fate of the following six species is of national significance.

The **silver-studded blue butterfly** *Plebejus argus*

The county lists for Norfolk and Suffolk both testify to the former abundance and wide distribution of this butterfly in the Brecks. Morley (1937) wrote, "Its headquarters with us are the Breck where it abounds from Brandon to Tuddenham as freely as in the New Forest or at Oxshott", while Barrett (1873) said it was "on all heaths" but later said "it was common on boggy heaths". Mendel and Piotrowski (1986) give the last sighting as Barton Mills 1965. They add that a significant factor in the butterfly's ecology was its preference for short turf and bare ground where *Calluna* succession was recent. J. Fenn (pers. comm.) said that the site at Barton Mills was the disused rifle range and there the butterfly existed in mini-colonies on short turf, isolated from each other by tall *Calluna vulgaris*. He revisited the site a few years later and found that the whole area was under pine and had become part of the Mildenhall Plantations.

Afforestation remains the primary reason for the loss of the *Calluna* heaths over the main range of the butterfly, which was the southern brecks of Norfolk and the greater part of the Suffolk ones. By 1965 the last of the big pine plantings in the King's Forest and at Mildenhall were finally closing canopy and the remaining *Calluna vulgaris* in them was dying out.

The **viper's bugloss moth** *Hadena irregularis* (RDB 1)

Formerly well known from the Suffolk sites at Icklingham, Worlington, Eriswell, Lakenheath, Tuddenham and Freckenham, together with Cranwich in Norfolk. However, by 1950 it was only found at Icklingham, Lakenheath, Eriswell and Cranwich and has not been seen since about 1960

Haggett (1951a, 1952) gives the most recent accounts of the moth's ecology and status. The species was usually seen in the larval stage as it rested on its sole foodplant, *Silene otites*; in 1951 at Cranwich 2,300 larvae, in all instars, were counted to the acre. It was always found at sites where its foodplant was abundant and never where populations of the plant were small and scattered. The foodplant has declined in many of its former stations and a survey in 1988 of moth and plant on 33 sites found *Silene otites* on only 16 sites, of these only eight had good populations of over 100 plants, and the moth could not be found.

Of the three most recently known sites for *Silene otites* in the area of Thetford Forest Park, all were in Norfolk and only the Cranwich plants were known to support the moth. In both the other two locations (Harling Woods) the plant is either drastically reduced and ride-shaded or totally lost.

The viper's bugloss moth is now believed to be extinct in Britain.

The **spotted sulphur moth** *Emmelia trabealis* (RDB 1)

In the last century this species was well distributed in the south and west of the Breck as far north as Merton and Didlington in Norfolk. Barrett (1893 - 1907) wrote "the moth frequents open fields especially those which are roughly cultivated or lying fallow". Morley (1937) states "locally quite abundant up to at least 1899 and it still persists in satisfactory numbers". Barrett (1901) said that it was "plentiful in the Breck district of Norfolk, Suffolk and Cambs". During the 1930's it was best known from Worlingham, Freckenham and Lakenheath. In 1951 it was found freely at Little Eriswell and on roadside verges at Mundford and Cranwich (Haggett, 1951b). The larval foodplant is *Convolvulus arvensis*, the larvae prefering plants which climb up grass stems. There is one recorded instance at Weeting, soon after the war, where the larva was found on convolvulus growing up asparagus. The spotted sulphur moth is now believed to be extinct in Britain.

The **tawny wave moth** *Scopula rubiginata* (RDB 3)

Barrett (1901) states "very common in the open fallow fields and in lucerne fields in the Breck district. Morley (1937) says "abundant at East Tuddenham in 1884 but extending to Brandon, Thetford, Barnham Heath and Eriswell in 1936. Barrett (1901) also records it "from boggy heaths around Norwich and King's Lynn but nothing has been seen of it there in modern times". There have been odd sightings made from time to time outside the Breck and it does have a station on the Suffolk coast at Thorpeness. Within the Breck it has always been a well distributed moth, though it was never found in large numbers at any one locality. It was of regular occurence with two broods in June and August and it was found to still be plentiful in 1951 (Haggett, 1951b). Although not recorded from the Forest Park area since 1987 the moth continues to appear occasionally in the surrounding Breck.

The **grey carpet moth** *Lithostege griseata* (RDB 3)

A Breckland speciality frequenting weedy arable land and, in modern times, only recorded in the Forest Park area on game-feed land at King's and near Brandon. Once present throughout Breckland, the larval foodplant is flixweed *Descurainia sophia* which requires recently turned soil on calcareous sites.

This is another Breck speciality found formerly in weedy arable land, especially in the vicinity of hay-ricks. Morley (1937) stated that it was "levelly distributed over the Breck district" but Barrett (1901) thought it to be "only very locally in the Breck". It may still quickly build up numbers, as it did at Centre Parcs (Elveden, Suffolk) in 1991, whenever site conditions favour its food, but it has yet to appear among prolific flixweed in today's fallow and unsprayed headlands and the moth remains generally uncommon.

The **four-spotted moth** *Tyta luctuosa* (RDB 2)

Known from Lynford and Cranwich from a former wide distribution on calcareous sites. Not recorded from forest areas now although still rare in Breckland.

A number of moths were commonly encountered throughout Breckland until recent years but are now localized, with very low and fragmented populations dependent on flowering Breck plants and within the Forest Park upon rideside and clearings. These moths are; the cream-spot tiger *Arctia villica britannica*, the marbled clover *Heliothis viriplaca*, the bordered gothic *Heliophobus reticulata marginosa*, the oblique striped *Phibalapteryx virgata*, the reddish light arches *Apamea sublustris*, the royal mantle *Catarhoe cuculata*, and the white colon *Sideridis albicolon*.

Some acid heath moths have disappeared due to diminished *Calluna* resource within the forest, but survive on the principal heaths of the surrounding brecks. They include the ling pug *Eupithecia absinthiata* f. *goossensiata*, the narrow-winged pug *Eupithecia nanata angusta*, the clouded buff *Diacrisia sannio*, the beautiful yellow underwing *Anarta myrtilli* and the anomalous *Stilbia anomala*.

Arrivals since afforestation include the comma *Polygonia c-album* and the white admiral *Ladoga camilla*, with the latter still only in the eastern forest broadleaved blocks. Two newcomers are remarkable in having Thetford Forest Park as one of only two centres in Britain - the white-banded carpet *Spargania luctuata*, a willow-herb feeder found across most of the central blocks of the forest and otherwise only in Kent and East Sussex, since 1950; and the pauper pug *Eupithecia egenaria* which feeds in flowers of the avenue limes and which is found

elsewhere only in the Wye valley, and dates from 1953. The pale-lemon sallow *Xanthia ocellaris* has occupied stands of poplar as it has elswhere in eastern England. Two moths not previously recorded from Norfolk are the satin beauty *Deileptenia ribeata* which is a birch and conifer feeder, and the barred tooth-striped *Trichopteryx polycommata* that here feeds only on privet. The pine hawk-moth *Hyloicus pinastri* has spread throughout southern and eastern England since 1920, being primarily a pine feeder. The larva of the curious little moth the waved black *Parascotia fuliginaria* lives on bracket fungi of dead wood and was unknown in this area until 1979.

Exclusively coniferous feeders comprise but 13 species, and they are all moths. Twelve have largely pine-eating larvae but some of these will also take larch and Douglas fir. Two eat cypress here and another spruce and Douglas fir, and one mainly larch. One is a yew/Douglas fir feeder that will take to pine and birch and there are an additional eight generalised broadleaved feeders that can take to the common conifers (Hatcher and Winter, 1990). No conifer feeder has caused defoliation problems at Thetford.

Afforestation is only one of the reasons for the decline of heathland lepidoptera, another being changes in agricultural practice. But whereas reduced sites for key species linger elsewhere in the Breck, within the forest area there have been few comparable refuges. It is sad to record that the only site to survive to the present day that is worthy of scheduling for its flora as well as its insects is Cranwich Camp, and this simply because the site has been under long-term lease to the Minstry of Defence.

Future prospects for Lepidoptera of Thetford Forest Park

The current success of Thetford Forest as a secondary habitat for common lepidoptera is attributed to the diversity of ground flora, woody shrubs and broadleaved trees present in Scots pine plantations. It follows that modern techniques that give better success in re-stocking with Corsican pine are likely to reduce this diversity and thus the lepidoptera that live there. Exclusive use of Corsican pine is in itself highly detrimental to ground flora and invertebrates because of its heavy needle litter which grows deeper, and lies unchanged from the time of canopy closure, while the canopy shade is itself much heavier than from Scots pine.

A short-rotation clearfall policy is advantageous in providing open bare-site conditions, but foodplants amongst the re-growth appear to support only the generalised species, and in a longer time-spell they may even be further reduced as Corsican pine impoverishes the seed-bank. The time young crops remain in weeding and cleaning is expected to be reduced in conjunction with chemical treatment, so the diversity of lepidoptera in this vital development phase will be reduced. But the worse prospect is that the surviving calcareous and acid heath insects may find their habitat even further reduced and so vanish from the forest.

The recommendations that follow assume that current trends in silvicultural techniques and use of Corsican pine will intensify.

Recommendations to assist survival of key and generalised Lepidoptera in Thetford Forest Park

1. Restoration of calcareous heath - creation of reserves.

As the most appropriate and economic time for the removal of land from cropping would be following clear-fall, the options for this are fast reducing in areas such as Mundford where there is the most need. Urgent consideration is therefore paramount. To be effective each reserve area would need to be of average compartment size (10 hectares), and preferably of more than one compartment size. Pig ranching would be detrimental to wildlife objectives but gameletting could be acceptable.

2. Ride widening.

Urgent and vigorous implementation of the Conservation Plan proposals for widening of rides on the calcareous and *Calluna* sites, and their expansion on selected sites to create mini reserves.

3. Open Spaces.

Retention and enlargement of open spaces and their combination with recreation development.

4. *Calluna* reserves.

The creation of further large *Calluna* reserves, such as that already made at King's Forest.

5. Scots Pine.

Maintain Scots pine and naturally regenerated crops on as many sites as possible.

6. Mature crops.

Maintain as large a total area of well distributed and over- mature conifer crops as can be compatible with other land use requirements, such as amenity and recreation.

Postscript February 1993

Since this paper was written the management of Thetford Forest Park has accepted its recommentations, and while not all of them have been expressed in the recent revision of the Conservation Plan, most are in some measure being implemented.

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References

ALLAN, P.B.M. 1949 *Larval Foodplants*. London: Watkins and Doncaster.

BARRETT, C.G. 1893-1907 *The Lepidoptera of the British Islands*. London: Lovell Reeve and Co. Ltd.

BARRETT, C.G. 1901 Lepidoptera. In *Victoria History of the Counties of England*, Norfolk vol.1, ed. H.A. Doubleday 135-162. Westminster: Archibald Constable.

BRADLEY, J.D. & FLETCHER, D.S. 1986 *An indexed list of British Butterflies and Moths*. Orpington: Kedleston Press.

CLAPHAM, A.R., TUTIN, T.G. & WARBURG, E.F. 1962 *Flora of the British Isles* 2nd ed. Cambridge: Cambridge University Press.

CLARKE, W.G. 1910 Botanical Notes From Breckland. *Trans.Norfolk Norwich Nat. Soc.* **9**, 8-16.

CLARKE, W.G. 1925 *In Breckland Wilds*. Cambridge: Heffer and Sons Ltd.

FORESTRY COMMISSION 1987 *Thetford Forest District Conservation Plan* (unpublished).

HADLEY, J. 1984 *A National Review of British Macrolepidoptera*. Nature Conservancy Council (Invertebrate Site Register) (unpublished report 46).

HAGGETT, G.M. 1951a Notes on Some Lepidoptera of Southwest Norfolk. *Entomologist's*

Gazette **2**, 133-138.
HAGGETT, G.M. 1951b Breckland notes with reference to the most important species. *Entomologist's Gazette* **2**, 198-201.
HAGGETT, G.M. 1951c Further notes from Norfolk and the Breck. *Entomologist's Gazette* **2**, 242.
HAGGETT, G.M. 1952 Observations on a colony of Anepia irregularis in Norfolk. *The Entomologist* **85**, 36-38.
HATCH, P.E. & WINTER, T.G. 1990 An Annotated Checklist of British Conifer-feeding Macrolepidoptera and their Foodplants. *Entomologist's Gazette* **41**, 177-196.
MENDEL, H. & PIOTROWSKI, S.H. 1986 *The Butterflies of Suffolk*. Ipswich: Suffolk Naturalists' Society.
MORLEY, C. 1937 *Final Catalogue of the Lepidoptera of Suffolk*. Memoirs of the Suffolk Naturalists' Society.
NATURE CONSERVANCY COUNCIL 1990 *Ecological Changes in Breckland*, ed. P.W. Lambley (unpublished).
ROTHAMSTED 1973-1986 *Light Trap Moth Records* Site 259 (Santon Downham, Suffolk). (unpublished)
SHIRT, D.B.(ed) 1987 *British Red Data Books: 2 Insects*. Peterborough: Nature Conservancy Council.

APPENDIX 1
Red Data Book and N.C.C. Notable a and b Lepidoptera of Thetford Forest Park

R *Hadena irregularis* Hufn.	Viper's Bugloss	RDB 1 - now extinct
R *Emmelia trabealis* Scop.	Spotted Sulphur	RDB 1 - now extinct
R *Perizoma sagittata* Fabr.	Marsh Carpet	RDB 2
R *Tyta luctuosa* D.& S.	The Four-spotted	RDB 2 - now endangered
R *Scopula rubiginata* Hufn.	Tawny Wave	RDB 3 - now endangered
Eupithecia egenaria H.-S.	Pauper Pug	RDB 3 (first Brit. record 1953)
R *Lithostege griseata* D.& S.	Grey Carpet	RDB 3
R *Senta flammea* Curt.	Flame Wainscot	RDB 3
R *Archanara algae* Esp.	Rush Wainscot	RDB 3
R *Heliothis viriplaca*	Marbled Clover	RDB 3 - now endangered
R *Sesia apiformis* Cl.	Hornet Moth	Na
R *Sesia bembeciformis* Hb.	Lunar Hornet Moth	Na
R *Idaea muricata* Hufn.	Purple-bordered Gold	Na
R *Phibalapteryx virgata* Hufn.	Oblique striped	Na
Spargania luctuata D.& S.	White-banded Carpet	Na (first Brit. record 1924)
R *Eupithecia insigniata* Hb.	Pinion-spotted Pug	Na
R *Eupithecia trisignaria* H.-S.	Triple-spotted Pug	Na
Chloroclystis chloerata Mab.	Sloe Pug	Na (first Brit. record 1971)
R *Anticollix sparsata* Treit.	Dentated Pug	Na
Trichopteryx polycommata D.& S.	Barred Tooth-striped	Na (first Norf. record 1980)
R *Hemaris fuciformis* Linn.	Broad-bordered Bee Hawk	Na
Xanthia ocellaris Borkh.	Pale-lemon Sallow	Na
R *Simyra albovenosa* Goeze	Reed Dagger	Na
R *Photedes fluxa* Hb.	Mere Wainscot	Na
Elaphria venustula Hb.	Rosy Marbled	Na (first Norf. record 1982)
R *Macrochilo cribrumalis* Hb.	Dotted Fan-foot	Na
R *Adscita statices* Linn.	The Forester	Nb
R *Apoda limacodes* Hufn.	The Festoon	Nb
R *Plebejus argus argus* Linn.	Silver-studded Blue	Nb - now extinct in Breck
R *Drepana cultraria* Fabr.	Barred Hook-tip	Nb
R *Rheumaptera cervinalis* Scop.	Scarce Tissue	Nb
R *Philereme vetulata* D.& S.	Brown Scallop	Nb
R *Eupithecia inturbata* Hb.	Maple Pug	Nb

R *Eupithecia valerianata* Hb.	Valerian Pug	Nb
R *Eupithecia subumbrata* D.& S.	Shaded Pug	Nb
R *Eupithecia indigata* Hb.	Ochreous Pug	++ Nb
R *Eupithecia pimpinellata* Hb.	Pimpinel Pug	Nb
R *Eupithecia dodoneata* Guen.	Oak-tree Pug	Nb
Ennomos autumnaria Werneb.	Large Thorn	Nb
Deileptenia ribeata Cl.	Satin Beauty	++ Nb
R *Paradarisa extersaria* Hb.	Brindled White-spot	Nb
R *Ptilodontella cucullina* D.& S.	Maple Prominent	Nb
R *Clostera pigra* Hufn.	Small Chocolate-tip	Nb
Rhyacia simulans Hufn.	Dotted Rustic	Nb
R *Noctua orbona* Hufn.	Lunar Yellow Underwing	Nb
R *Xestia rhomboidea* Esp.	Square-spotted Clay	Nb
R *Sideridis albicolon* Hb.	White Colon	Nb
R *Heliophobus reticulata marginosa*	Haw. Bordered Gothic	Nb - now endangered in Breck
R *Orthosia populeti* Fabr.	Lead-coloured Drab	Nb
R *Apamea sublustris* Esp.	Reddish Light Arches	Nb
R *Archanara geminipuncta* Haw.	Twin-spotted Wainscot	Nb
R *Archanara dissoluta* Treit.	Brown-veined Wainscot	Nb
R *Chilodes maritimus* Tausch.	Silky Wainscot	Nb
R *Deltote uncula* Cl.	Silver Hook	Nb
R *Earias clorana* Linn.	Cream-bordered Green Pea	Nb
Parascotia fuliginaria Linn.	Waved Black	Nb

R indicates species resident before afforestation

++ indicates species with conifer feeding larvae

APPENDIX 2

Lepidoptera species found in each of the habitat types listed in table 6

The list of species recorded from the area of Thetford Forest Park has been compiled from the sources listed in Acknowledgements and References. The great majority of species continue to be recorded by local workers and by visitors.

We have omitted vagrants and also a few species for which the status is undetermined, but which on evidence to date are likely to be migratory - these include *Eurois occulta* Linn., *Hoplodrina ambigua* D.& S., *Autographa bractea* D.& S., as well as common migrant butterflies. We have rejected a very small number of other records.

Allocation to habitats presents numerous problem species that wander, and indeed under the most propitious flight conditions almost any vigorous flier might be encountered away from its breeding site. We have endeavoured to group species that are typical of their habitat and in some instances have been guided by the habits of the larva, and in particular its food distribution where this is ecologically restricted in Breckland: for instance the larva of Noctua orbona will have been found only on acid sites even though the moth is found in other locations.

2a - Generalised species from more than one habitat

Hepialus humuli humuli Linn.	Ghost Moth
Hepialus sylvina Linn.	Orange Swift
Hepialus hecta Linn.	Gold Swift
Hepialus lupulinus Linn.	Common Swift
Zeuzera pyrina Linn.	Leopard Moth
Sesia bembiciformis Hb.	Lunar Hornet Moth
Thymelicus sylvestris Poda	Small Skipper
Ochlodes venata faunus Turati	Large Skipper
Gonepteryx rhamni rhamni Linn	The Brimstone
Pieris brassicae Linn.	Large White
Pieris rapae Linn.	Small White
Pieris napi sabellicae Steph.	Green-veined White
Anthocharis cardamines britannica Ver.	Orange-tip
Aglais urticae Linn.	Small Tortoiseshell

Inachis io Linn.	The Peacock
Pyronia tithonus britanniae Ver.	The Gatekeeper
Maniola jurtina insularis Thompson	Meadow Brown
Poecilocampa populi Linn.	December Moth
Lasiocampa quercus quercus Linn.	Oak Eggar
Philudoria potatoria Linn.	The Drinker
Gastropacha quercifolia Linn.	The Lappet
Cilix glaucata Scop.	Chinese Character
Thyatira batis Linn.	Peach Blossom
Habrosyne pyritoides Hufn.	Buff Arches
Alsophila aescularia D.& S.	March Moth
Jodis lactearia Linn.	Little Emerald
Timandra griseata Peters.	Blood-vein
Scopula imitaria Hb.	Small Blood-vein
Scopula floslactata floslactata Haw.	Cream Wave
Idaea biselata Hufn.	Small Fan-footed Wave
Idaea seriata Schr.	Small Dusty Wave
Idaea dimidiata Hufn.	Single-dotted Wave
Idaea aversata Linn.	Riband Wave
Xanthorhoe spadicearia D.& S.	Red Twin-spot Carpet
Xanthorhoe ferrugata Cl.	Dark-barred Twin-spot Carpet
Xanthorhoe quadrifasciata Cl.	Large Twin-spot Carpet
Xanthorhoe montanata montanata D.& S.	Silver-ground Carpet
Xanthorhoe fluctuata fluctuata Linn.	Garden Carpet
Scotopteryx chenopodiata Linn.	Shaded Broad-bar
Epirrhoe alternata alternata Mull.	Common Carpet
**Epirrhoe rivata* Hb.	Wood Carpet
Camptogramma bilineata bilineata Linn.	Yellow Shell
Larentia clavaria Haw.	The Mallow
Anticlea badiata D.& S.	Shoulder Stripe
Anticlea derivata D.& S.	The Streamer
Pelurga comitata Linn.	Dark Spinach
Eulithis testata Linn.	The Chevron
Eulithis pyraliata D.& S.	Barred Straw
Ecliptopera silaceata D.& S.	Small Phoenix
**Chloroclysta miata* Linn.	Autumn Green Carpet
Chloroclysta citrata citrata Linn.	Dark Marbled Carpet
Chloroclysta truncata Hufn.	Common Marbled Carpet
Cidaria fulvata Forst.	Barred Yellow
Plemyria rubiginata rubiginata D.& S.	Blue-bordered Carpet
Colostygia pectinataria Knoch	Green Carpet
Hydriomena furcata Thunb.	July Highflyer
Horisme vitalbata D.& S.	Small Waved Umber
**Horisme tersata* D.& S.	The Fern
Melanthia procellata D.& S.	Pretty Chalk Carpet
Rheumaptera cervinalis Scop.	Scarce Tissue
**Triphosa dubitata* Linn.	The Tissue
Philereme vetulata D.& S.	Brown Scallop
Philereme transversata britannica Lempke	Dark Umber
Euphyia unangulata Haw.	Sharp-angled Carpet
Epirrita christyi Allen	Pale November Moth
Epirrita autumnata Borkh.	Autumnal Moth
Operophtera brumata Linn.	Winter Moth
Perizoma alchemillata Linn.	Small Rivulet
Perizoma bifaciata Haw.	Barred Rivulet
Perizoma flavofasciata Thunb.	Sandy Carpet
Perizoma didymata didymata Linn.	Twin-spot Carpet
Eupithecia exiguata exiguata Hb.	Mottled Pug
Eupithecia insigniata Hb.	Pinion-spotted Pug
Eupithecia pygmaeata Hb.	Marsh Pug
Eupithecia centaureata D.& S.	Lime-speck Pug

Eupithecia absinthiata Cl.	Wormwood Pug
Eupithecia assimilata Doubl.	Currant Pug
Eupithecia vulgata vulgata Haw.	Common Pug
Eupithecia tripunctaria H.-S.	White-spotted Pug
Eupithecia subfuscata Haw.	Grey Pug
Eupithecia succenturiata Linn.	Bordered Pug
**Eupithecia fraxinata* Crewe	Ash Pug
Chloroclystis v-ata Haw.	The V-Pug
**Chloroclystis chloerata* Mab.	Sloe Pug
Chloroclystis rectangulata Linn.	Green Pug
Gymnoscelis rufifasciata Haw.	Double-striped Pug
**Trichopteryx polycommata* D.& S.	Barred Tooth-striped
Acasis viretata Hb.	Yellow-barred Brindle
Abraxas grossulariata Linn.	The Magpie
Lomaspilis marginata Linn.	Clouded Border
Ligdia adustata D.& S.	Scorched Carpet
Petrophora chlorosata Scop.	Brown Silver-line
Opisthograptis luteolata Linn.	Brimstone Moth
**Ennomos autumnaria* Werneb.	Large Thorn
Ourapteryx sambucaria Linn.	Swallow-tailed Moth
Apocheima pilosaria D.& S.	Pale Brindled Beauty
Biston betularia Hufn.	Peppered Moth
Agriopis marginaria Fabr.	Dotted Border
Erannis defoliaria Cl.	Mottled Umber
Menophra abruptaria Thunb.	Waved Umber
Peribatodes rhomboidaria D.& S.	Willow Beauty
Alcis repandata repandata Linn.	Mottled Beauty
Ectropis bistortata Goeze	The Engrailed
Ectropis crepuscularia D.& S.	Small Engrailed
Aethalura punctulata D.& S.	Grey Birch
Cabera pusaria Linn.	Common White Wave
Cabera exanthemata Scop.	Common Wave
Lomographa bimaculata Fabr.	White-pinion Spotted
Lomographa temerata D.& S.	Clouded Silver
Theria primaria Haw.	Early Moth
Campaea margaritata Linn.	Light Emerald
Sphinx ligustri Linn.	Privet Hawk-moth
Mimas tiliae Linn.	Lime Hawk-moth
Smerinthus ocellata Linn.	Eyed Hawk-moth
Laothoe populi Linn.	Poplar Hawk-moth
**Hemaris fuciformis* Linn.	Broad-bordered Bee Hawk-moth
Deilephila elpenor Linn.	Elephant Hawk-moth
Phalera bucephala Linn.	Buff-tip
Cerura vinula Linn.	Puss Moth
Furcula furcula Cl.	Sallow Kitten
Notodonta dromedarius Linn.	Iron Prominent
Eligomodonta ziczac Linn.	Pebble Prominent
Pheosia gnoma Fabr.	Lesser Swallow Prominent
Pheosia tremula Cl.	Swallow Prominent
Ptilodon capucina Linn.	Coxcomb Prominent
Pterostoma palpina Cl.	Pale Prominent
Clostera curtula Linn.	Chocolate-tip
Diloba caerulocephala Linn.	Figure of Eight
Orgyia antiqua Linn.	The Vapourer
Euproctis similis Fuess.	Yellow-tail
Leucoma salicis Linn.	White Satin Moth
Thumatha senex Hb.	Round-winged Muslin
Eilema griseola Hb.	Dingy Footman
Eilema complana Linn.	Scarce Footman
Eilema lurideola Zinck.	Common Footman
Arctia caja Linn.	Garden Tiger

Spilosoma lubricipeda Linn.	White Ermine
Spilosoma luteum Hufn.	Buff Ermine
Diaphora mendica Cl.	Muslin Moth
Phragmatobia fuliginosa fuliginosa Linn.	Ruby Tiger
Nola cucullatella Linn.	Short-cloaked Moth
Euxoa nigricans Linn.	Garden Dart
Agrotis segetum D.& S.	Turnip Moth
Agrotis exclamationis Linn.	Heart and Dart
Agrotis puta puta Hb.	Shuttle-shaped Dart
Axylia putris Linn.	The Flame
Ochropleura plecta Linn.	Flame Shoulder
**Rhyacia simulans* Hufn.	Dotted Rustic
Noctua pronuba Linn.	Large Yellow Underwing
Noctua comes Hb.	Lesser Yellow Underwing
Noctua fimbriata Schreb.	Broad-bordered Yellow Underwing
Noctua janthina D.& S.	Lesser Broad-bordered Yellow Underwing
Noctua interjecta caliginosa Schaw.	Least Yellow Underwing
Diarsia rubi View.	Small Square-spot
Xestia c-nigrum Linn.	Setaceous Hebrew Character
Xestia ditrapezium D.& S.	Triple-spotted Clay
Xestia triangulum Hufn.	Double Square-spot
Xestia baja D.& S.	Dotted Clay
Xestia rhomboidea Esp.	Square-spotted Clay
Xestia sexstrigata Haw.	Six-striped Rustic
Xestia xanthographa D.& S.	Square-spot Rustic
Naenia typica Linn.	The Gothic
Anaplectoides prasina D.& S.	Green Arches
Cerastis rubricosa D.& S.	Red Chestnut
Dicestra trifolii Hufn.	The Nutmeg
Polia nebulosa Hufn.	Grey Arches
Mamestra brassicae Linn.	Cabbage Moth
Melanchra persicariae Linn.	Dot Moth
Lacanobia w-latinum Hufn.	Light Brocade
Lacanobia thalassina Hufn.	Pale-shouldered Brocade
Lacanobia oleracea Linn.	Bright-line Brown-eye
Ceramica pisi Linn.	Broom Moth
**Hadena compta* D.& S.	Varied Coronet
Hadena bicruris Hufn.	The Lychnis
Cerapteryx graminis Linn.	Antler Moth
Tholera cespitis D.& S.	Hedge Rustic
Tholera decimalis Poda	Feathered Gothic
Orthosia cruda D.& S.	Small Quaker
**Orthosia opima* Hb.	Northern Drab
Orthosia gracilis D.& S.	Powdered Quaker
Orthosia cerasi Fabr.	Common Quaker
Orthosia incerta Hufn.	Clouded Drab
Orthosia gothica Linn.	Hebrew Character
Mythimna ferrago Fabr.	The Clay
Mythimna impura impura Hb.	Smoky Wainscot
Mythimna pallens Linn.	Common Wainscot
Mythimna comma Hb.	Shoulder-striped Wainscot
Brachylomia viminalis Fabr.	Minor Shoulder-knot
**Aporophyla nigra* Haw.	Black Rustic
Allophyes oxyacanthae Linn.	Green-brindled Crescent
Mniotype adusta Esp.	Dark Brocade
**Polymixis flavicincta* D.& S.	Large Ranunculus
Agrochola lota Cl.	Red-line Quaker
Agrochola litura Linn.	Brown-spot Pinion
Agrochola lychnidis D.& S.	Beaded Chestnut
Atethmia centrago Haw.	Centre-barred Sallow
Xanthia togata Esp.	Pink-barred Sallow

Xanthia icteritia Hufn.	The Sallow
Acronicta leporina Linn.	The Miller
Acronicta tridens D.& S.	Dark Dagger
Acronicta psi Linn.	Grey Dagger
Cryphia domestica Hufn.	Marbled Beauty
Amphipyra tragopogonis Cl.	Mouse Moth
Mormo maura Linn.	Old Lady
Rusina ferruginea Esp.	Brown Rustic
Euplexia lucipara Linn.	Small Angle Shades
Phlogophora meticulosa Linn.	Angle Shades
**Parastichtis suspecta* Hb.	The Suspected
Cosmia trapezina Linn.	The Dun-bar
Cosmia pyralina D.& S.	Lunar-spotted Pinion
Apamea monoglypha Hufn.	Dark Arches
Apamea lithoxylaea D.& S.	Light Arches
Apamea crenata Hufn.	Clouded-bordered Brindle
Apamea epomidion Haw.	Clouded Brindle
Apamea remissa Hb.	Dusky Brocade
Apamea anceps D.& S.	Large Nutmeg
Apamea sordens Hufn.	Rustic Shoulder-knot
Oligia strigilis Linn.	Marbled Minor
**Oligia versicolor* Borkh.	Rufous Minor
Oligia latruncula D.& S.	Tawny Marbled Minor
Oligia fasciuncula Haw.	Middle-barred Minor
Mesoligia furuncula D.& S.	Cloaked Minor
Mesoligia literosa Haw.	Rosy Minor
Mesapamea secalis Linn.	Common Rustic
Photedes fluxa Hb.	Mere Wainscot
Luperina testacea D.& S.	Flounced Rustic
Amphipoea oculea Linn.	Ear Moth
Hydraecia micacea Esp.	Rosy Rustic
Gortyna flavago D.& S.	Frosted Orange
Charanyca trigrammica Hufn.	Treble Lines
Hoplodrina alsines Brahm	The Uncertain
Hoplodrina blanda D.& S.	The Rustic
Caradrina morpheus Hufn.	Mottled Rustic
Caradrina clavipalpis Scop.	Pale Mottled Willow
**Elaphria venustula* Hb.	Rosy Marbled
**Panemeria tenebrata* Scop.	Small Yellow Underwing
Protodeltote pygarga Hufn.	Marbled White Spot
Diachrysia chrysitis Linn.	Burnished Brass
Autographa gamma Linn.	Silver Y
Autographa pulchrina Haw.	Beautiful Golden Y
Autographa jota Linn.	Plain Golden Y
**Abrostola trigemina* Werneb.	Dark Spectacle
Abrostola triplasia Linn.	The Spectacle
Lygephila pastinum Treit.	The Blackneck
Scoliopteryx libatrix Linn.	The Herald
Rivula sericealis Scop.	Straw Dot
Hypena probiscidalis Linn.	The Snout
Herminia tarsipennalis Treit.	The Fan-foot
Herminia grisealis D.& S.	Small Fan-foot
**Parascotia fuliginaria* Linn.	Waved Black

* indicates species that are scarce in Thetford Forest Park

2b - Broadleaved Forest

Apoda limacodes Hufn.	The Festoon
Pyrgus malvae Linn.	Grizzled Skipper
Quercusia quercus Linn.	Purple Hairstreak

Stymonidia w-album Knoch	White Letter Hairstreak
Celastrina argiolus britanna Ver.	Holly Blue
**Ladoga camilla* Linn.	White Admiral
**Polygonia c-album* Linn.	The Comma
Pararge aegeria tircis Butl.	Speckled Wood
Aphantopus hyperantus Linn.	The Ringlet
Falcaria lacertinaria Linn.	Scalloped Hook-tip
Drepana binaria Hufn.	Oak Hook-tip
Drepana cultraria Fabr.	Barred Hook-tip
Drepana falcataria falcataria Linn.	Pebble Hook-tip
Tethea ocularis octogesimea Hb.	Figure of Eighty
Ochropacha duplaris Linn.	Common Lutestring
Cymatophorima diluta hartwiegi Reisser	Oak Lutestring
Achyla flavicornis galbanus Tutt	Yellow Horned
Polyploca ridens Fabr.	Frosted Green
Archiearis parthenias Linn.	Orange Underwing
Geometra papilionaria Linn.	Large Emerald
Comibaena bajularia D.& S.	Blotched Emerald
Hemithea aestivaria Hb.	Common Emerald
Cyclophora albipunctata Hufn.	Birch Mocha
Cyclophora porata Linn.	False Mocha
Cyclophora punctaria Linn.	Maiden's Blush
Cyclophora linearia Hb.	Clay Triple-lines
Idaea trigeminata Haw.	Treble Brown Spot
Idaea straminata Borkh.	Plain Wave
Mesoleuca albicillata Hb.	Beautiful Carpet
Chloroclysta siterata Hufn.	Red-green Carpet
Electrophaes corylata Thunb.	Broken-barred Carpet
**Spargania luctuata* D.& S.	White-banded Carpet
Epirrita dilutata D.& S.	November Moth
Operophtera fagata Scharf.	Northern Winter Moth
Perizoma affinitata Steph.	The Rivulet
Eupithecia inturbata Hb.	Maple Pug
Eupithecia pulchellata pulchellata Steph.	Foxglove Pug
**Eupithecia egenaria* H.-S.	Pauper Pug
Eupithecia abbreviata Steph.	Brindled Pug
Eupithecia dodoneata Guen.	Oak-tree Pug
Asthena albulata Hufn.	Small White Wave
Hydrelia flammeolaria Hufn.	Small Yellow Wave
Lobophora halterata Hufn.	The Seraphim
Trichopteryx carpinata Borkh.	Early Tooth-striped
Abraxas sylvata Scop.	Clouded Magpie
Plagodis pulveraria Linn.	Barred Umber
Plagodis dolabraria Linn.	Scorched Wing
Apeira syringaria Linn.	Lilac Beauty
Ennomos quercinaria Hufn.	August Thorn
Ennomos alniaria Linn.	Canary-shouldered Thorn
Ennomos fuscantaria Haw.	Dusky Thorn
Ennomos erosaria D.& S.	September Thorn
Selenia dentaria Fabr.	Early Thorn
Selenia lunularia Hb.	Lunar Thorn
Selenia tetralunaria Hufn.	Purple Thorn
Odontopera bidentata Cl.	Scalloped Hazel
Crocallis elinguaria Linn.	Scalloped Oak
Colotois pennaria Hb.	Feathered Thorn
Apocheima hispidaria D.& S.	Small Brindled Beauty
Lycia hirtaria Cl.	Brindled Beauty
Biston strataria Hufn.	Oak Beauty
Agriopis leucophaearia D.& S.	Spring Usher
Agriopis aurantiaria Hb.	Scarce Umber
Serraca punctinalis Scop.	Pale Oak Beauty

Cleorodes lichenaria Hufn.	Brussels Lace
Paradarisa extersaria Hb.	Brindled White-spot
Furcula bifida Brahm	Poplar Kitten
Stauropus fagi Linn.	Lobster Moth
Peridea anceps Goeze	Great Prominent
Ptilodontella cucullina D.& S.	Maple Prominent
Drymonia dodonaea D.& S.	Marbled Brown
Drymonia ruficornis Hufn	Lunar Marbled Brown
Calliteara pudibunda Linn.	Pale Tussock
Lymantria monacha Linn.	Black Arches
Miltochrista miniata Forst.	Rosy Footman
Eilema deplana Esp.	Buff Footman
Nola confusalis H.-S.	Least Black Arches
Graphiphora augur Fabr.	Double Dart
Diarsia mendica mendica Fabr.	Ingrailed Clay
Diarsia brunnea D.& S.	Purple Clay
Orthosia populeti Fabr.	Lead-coloured Drab
Orthosia munda D.& S.	Twin-spotted Quaker
Brachionycha sphinx Hufn.	The Sprawler
Lithophane semibrunnea Haw.	Tawny Pinion
Lithophane ornitopus lactipennis Dadd	Grey Shoulder-knot
Xylocampa areola Esp.	Early Grey
Dichonia aprilina Linn.	Merveille du Jour
Dryobotedes eremita Fabr.	Brindled Green
Eupsilia transversa Hufn.	The Satellite
Conistra vacinii Linn.	The Chestnut
Agrochola circellaris Hufn.	The Brick
Agrochola macilenta Hb.	Yellow-line Quaker
Agrochola helvola Linn.	Flounced Chestnut
Xanthia citrago Linn.	Orange Sallow
Xanthia aurago D.& S.	Barred Sallow
Acronicta megacephala D.& S.	Poplar Grey
Acronicta aceris Linn.	The Sycamore
Acronicta alni Linn.	Alder Moth
Craniophora ligustri D.& S.	The Coronet
Amphipyra pyramidea Linn.	Copper Underwing
Dypterygia scabriuscula Linn.	Bird's Wing
Ipimorpha subtusa D.& S.	The Olive
Apamea scolopacina Esp.	Slender Brindle
Bena prasinana Linn.	Scarce Silver-lines
Pseudoips fagana britannica Warr.	Green Silver-lines
Nycteola revayana Scop.	Oak Nycteoline
Colocasia coryli Linn.	Nut-tree Tussock
Laspeyria flexula D.& S.	Beautiful Hook-tip

* indicates species not recorded by Barrett (1901) or Morley (1937) from the Breck.

2c - Calcareous Heath

**Adscita statices* Linn.	The Forester
Zygaena filipendulae stephensi Dupont	Six-spot Burnet
Zygaena lonicerae latomarginata Tutt	Narrow-bordered Five-spot Burnet
Thymelicus lineola Ochs.	Essex Skipper
**Erynnis tages tages* Linn.	Dingy Skipper
Aricia agestis D.& S.	Brown Argus
Polyommatus icarus icarus Rott.	Common Blue
Lasiommata megera Linn.	The Wall
Coenonympha pamphilus pamphilus Linn.	Small Heath
**Scopula rubiginata* Hufn.	Tawny Wave

**Phibalapteryx virgata* Hufn.	Oblique Striped
Catarhoe cuculata Hufn.	Royal Mantle
Cosmorhoe ocellata Linn.	Purple Bar
**Colostygia multistrigaria* Haw.	Mottled Grey
Eupithecia haworthiata Doubl.	Haworth's Pug
Eupithecia linariata D.& S.	Toadflax Pug
Eupithecia venosata venosata Fabr.	Netted Pug
Eupithecia satyrata satyrata Hb.	Satyr Pug
Eupithecia icterata subfulvata Haw.	Tawny Speckled Pug
Eupithecia subumbrata D.& S.	Shaded Pug
**Eupithecia pimpinellata* Hb.	Pimpinel Pug
**Aplocera plagiata plagiata* Linn.	Treble-bar
**Aplocera efformata* Guen.	Lesser Treble-bar
**Lithostege griseata* D.& S.	Grey Carpet
Semiothisa clathrata clathrata Linn.	Latticed Heath
Pseudopanthera macularia Linn.	Speckled Yellow
Aspitates ochrearia Rossi	Yellow Belle
Deilephila porcellus Linn	Small Elephant Hawk-moth
Tyria jacobaeae Linn.	The Cinnabar
Hada nana Hufn.	The Shears
**Sideridis albicolon* Hb.	White Colon
**Heliophobus reticulata marginosa* Haw.	Bordered Gothic
Hecatera bicolorata Hufn.	Broad-barred White
Hadena rivularis Fabr.	The Campion
Hadena perplexa perplexa D.& S.	Tawny Shears
Hadena confusa Hufn.	Marbled Coronet
Mythimna conigera D.& S.	Brown-line Bright-eye
**Cucullia chamomillae* D.& S.	Chamomile Shark
Cucullia umbratica Linn.	The Shark
Cucullia verbasci Linn.	The Mullein
Omphaloscelis lunosa Haw.	Lunar Underwing
Thalpophila matura Hufn.	Straw Underwing
**Apamea sublustris* Esp.	Reddish Light Arches
Eremobia ochroleuca D.& S.	Dusky Sallow
**Pyrrhia umbra* Hufn.	Bordered Sallow
**Heliothis viriplaca* Hufn.	Marbled Clover
Callistege mi Cl.	Mother Shipton
Euclidia glyphica Linn.	Burnet Companion

Present in 1950

Hadena irregularis Hufn.	Viper's Bugloss
Emmelia trabealis Scop.	Spotted Sulphur
Tyta luctuosa D.& S.	The Four-spotted

* indicates species that are scarce and/or declining in Thetford Forest Park

2d Acid Heath

Callophrys rubi Linn.	Green Hairstreak
Lycaena phlaeas eleus Fabr.	Small Copper
Hipparchia semele semele Linn.	The Grayling
Macrothylacia rubi Linn.	Fox Moth
Pavonia pavonia Linn.	Emperor Moth
Pseudoterpna pruinata atropunctaria Walk.	Grass Emerald
Idaea subsericeata Haw.	Satin Wave
**Scotopteryx luridata plumbaria* Fabr.	July Belle
**Eupithecia absinthiata* f.*goossensiata* Mab.	Ling Pug
**Eupithecia nanata angusta* Prout	Narrow-winged Pug
Chesias legatella D.& S.	The Streak

Chesias rufata rufata Fabr.	Broom-tip
Ematurga atomaria atomaria Linn.	Common Heath
Cybosia mesomella Linn.	Four-dotted Footman
**Arctia villica britannica* Ob.	Cream-spot Tiger
**Diacrisia sannio* Linn.	Clouded Buff
Euxoa tritici Linn.	White-line Dart
Agrotis vestigialis Hufn.	Archer's Dart
Agrotis clavis Hufn.	Heart and Club
**Noctua orbona* Hufn.	Lunar Yellow Underwing
Paradiarsia glareosa glareosa Esp.	Autumnal Rustic
Lycophotia porphyrea D.& S.	True Lover's Knot
**Anarta myrtilli* Linn.	Beautiful Yellow Underwing
Aporophyla lutulenta lutulenta D.& S.	Deep-brown Dart
**Stilbia anomala* Haw.	The Anomalous

Present in 1950

Plebejus argus argus Linn.	Silver-studded Blue

* indicates species that are scarce and/or declining in Thetford Forest Park

2e - Wetlands

Sesia apiformis Cl.	Hornet Moth
Scopula immutata Linn.	Lesser Cream Wave
Idaea muricata Hufn.	Purple-bordered Gold
Idaea emarginata Linn.	Small Scallop
Orthonama vittata Borkh.	Oblique Carpet
Xanthorhoe designata Hufn.	Flame Carpet
Lampropteryx suffumata D.& S.	Water Carpet
Eulithis prunata Linn.	The Phoenix
Eulithis mellinata Fabr.	The Spinach
Hydriomena impluviata D.& S.	May Highflyer
Rheumaptera undulata Linn.	Scallop Shell
Perizoma albulata albulata D.& S.	Grass Rivulet
Perizoma sagittata Fabr.	Marsh Carpet
Eupithecia tenuiata Hb.	Slender Pug
Eupithecia valerianata Hb.	Valerian Pug
Eupithecia trisignaria H.-S.	Triple-spotted Pug
Anticollix sparsata Treit.	Dentated Pug
Euchoeca nebulata Scop.	Dingy Shell
Pterapherapteryx sexalata Reitz.	Small Seraphim
Semiothisa wauaria Linn.	The V-Moth
Epione repandaria Hufn.	Bordered Beauty
Clostera pigra Hufn.	Small Chocolate Tip
Nudaria mundana Linn.	Muslin Footman
Lacanobia suasa D.& S.	Dog's Tooth
Mythimna pudorina D.& S.	Striped Wainscot
Senta flammea Curt.	Flame Wainscot
+*Xanthia ocellaris* Borkh.	Pale-lemon Sallow
Simyra albovenosa Goeze	Reed Dagger
Parastichtis ypsillon D.& S.	Dingy Shears
Apamea unanimis Hb.	Small Clouded Brindle
Apamea ophiogramma Esp.	Double Lobed
Photedes minima Haw.	Small Dotted Buff
Photedes pygmina Haw.	Small Wainscot
Calaena leucostigma leucostigma Hb.	The Crescent
Nonagria typhae Thunb.	Bulrush Wainscot
Archanara geminipuncta Haw.	Twin-spotted Wainscot
Archanara dissoluta Treit.	Brown-veined Wainscot
Archanara algae Esp.	Rush Wainscot

Rhizedra lutosa Hb.	Large Wainscot
Arenostola phragmitidis Hb.	Fen Wainscot
Coenobia rufa Haw.	Small Rufous
Chilodes maritimus H.-S.	Silky Wainscot
Deltote uncula Cl.	Silver Hook
Earias clorana Linn.	Cream-bordered Green Pea
Catocala nupta Linn.	Red Underwing
Schrankia costaestrigalis Steph.	Pinion-streaked Snout
Macrochilo cribrumalis Hb.	Dotted Fan-foot

+ indicates species not recorded from the Breck by Barrett (1901) but well established by 1937 (Morley).

2f - Conifer Forest

Thera firmata Hb.	Pine Carpet
Thera obeliscata Hb.	Grey Pine Carpet
++*Eupithecia intricata arceuthata* Freyer	Freyer's Pug
Eupithecia indigata Hb.	Ochreous Pug
Eupithecia pusillata pusillata D.& S.	Juniper Pug
Eupithecia lariciata Freyer	Larch Pug
++*Eupithecia tantillaria* Boisd.	Dwarf Pug
Semiothisa liturata Cl.	Tawny-barred Angle
++*Deileptenia ribeata* Cl.	Satin Beauty
Bupalus piniaria Linn.	Bordered White
Hylaea fasciaria Linn.	Barred Red
++*Hyloicus pinastri* Linn.	Pine Hawk-moth
Panolis flammea D.& S.	Pine Beauty

++ indicates species not recorded from the Breck by Barrett (1901) or Morley (1937).

APPENDIX 3

Number of species of macro-lepidoptera larvae listed by foodplant within each of the six habitat groups discussed for the Thetford Forest Park.

Larval Foodplant	Number of macro-lepidoptera larvae by habitat						
	Two or more	Broad -leaf	Chalk Heath	Acid Heath	Wet Lands	Coni-fers	Total
Abies spp.						4	4
Acer campestre	25	19					44
Acer pseudoplanatus	23	11					34
Achillea millefolium	2		1				3
Algae	2	3		1			6
Alnus glutinosa	36	13			2		51
Arctium spp.	11	11					
Artemisia spp.	4	1					5
Berberis vulgaris & *Mahonia aquifolium*		1					1
Betula spp.	56	43	1	1			101
Calluna vulgaris	7			8			15
Castanea sativa	15	7					22
Carex spp. & *Juncus* spp.					5		5
Centaurea spp.			1				1
Chenopodium spp.	14						14
Cirsium spp.	2		2				4

Larval Foodplant	Number of macro-lepidoptera larvae by habitat						Total
	Two or more	Broad -leaf	Chalk Heath	Acid Heath	Wet Lands	Coni-fers	
Clematis vitalba	1		1				2
Cornus sanguinea	34	3		1			38
Corylus avellana	27	16		1			44
Crataegus spp.	61	21	1	1			84
Crepis spp. (and other Compositae)			6				6
Cruciferae	20				1		21
Cytisus scoparius	15			4			19
decaying vegetation	1			1	1		3
Descurainia sophia			3				3
Digitalis purpurea	23	2					25
Echium vulgare	1						1
Epilobium spp.	2	1					3
Euonymus europaeus	15	1					16
Eupatorium cannabinum	8						8
Fagus sylvatica	17	22					39
Filipendula ulmaria	14		1	1	1		17
Fragaria vesca	16	1	1				18
Fraxinus excelsior	18	16					34
Fungi						1	1
Galeopsis spp.	1						1
Galium verum	35		6	4			45
Galium spp. (other than *G.verum*)	39	1		3	3		46
Geraniaceae			1				1
Gramineae	38	2	9	4	4		57
Hedera helix	4	2					6
Helianthemum nummularium	1		2				3
Humulus lupulus	5	2					7
Hypericum spp.			3				3
Ilex aquifolium	4	1					5
Iris spp.	3				1		4
Lamium spp.	35	2		2			39
Larix spp.	2					9	11
Lichens	4	1					5
Ligustrum vulgare	26	8	2				36
Linaria vulgaris	2		2				4
Lonicera periclymenum	26	11					37
Lotus spp. & *Trifolium* spp.	12		8				20
Lysimachia spp.	1	1		1			3
Malus sylvestris	33	13					46
Malva spp.	2						2
Matricaria spp.			2				2
Minor Conifers	1				7		8
Odontites verna	1						1
Ononis spp.	17	1	5				23
Phalaris arundinacea	1						1
Phragmites australis	2				7		9

Larval Foodplant	Number of macro-lepidoptera larvae by habitat						
	Two or more	Broad -leaf	Chalk Heath	Acid Heath	Wet Lands	Coni-fers	Total
Picea spp.		1				6	7
Pinus spp.	1	1				10	12
Plantago spp.	39	2	1	3	1		46
Populus tremula	27	17					44
Populus spp. (other than *P. tremula*)	32	11			1		44
Potentilla spp.	1	1			1		3
Primula spp.	35	2					37
Prunus padus	10						10
Prunus spinosa	50	17	1	1			69
Prunus spp. (not *P. padus* or *P. spinosa*)	11	9					20
Pseudotsuga menziesii						8	8
Pteris spp.	4						4
Quercus petraea and *Quercus robur*	36	55					91
Reseda spp.	3		3				6
Rhamnus catharticus	24	6		1			31
Rhinanthus spp.			1		1		2
Ribes spp.	14	1			3		18
Rosa spp.	27	11					38
Rubus fruticosus aggregate	30	3	1	2			36
Rubus idaeus	31	3		1			35
Rumex spp. - Docks	55	5	1	3	1		65
Rumex spp. - Sorrels	10	2		4			16
Salix spp.	75	24			7		105
Sambucus nigra	19						19
Senecio spp.	8		1	1			10
Silene dioica	6	1					7
Silene latifolia alba	7						7
Silene otites			3				3
Silene vulgaris	17		7				24
Sorbus aucuparia	22	5					27
Stellaria spp.	53	3	2				58
Syringa vulgaris	17	8					25
Taraxacum spp.	45	2	1	4			52
Taxus baccata						1	1
Teucrium spp.	2		1				3
Thalictrum flavum					1		1
Tilia spp.	22	20					42
Typha spp.					1		1
Ulex spp.	1	1		4			6
Ulmus spp.	35	25		1			61
Umbelliferae - flowers	6		3		1		10
Urtica spp.	24	1					25
Valeriana spp.			1		2		3
Verbascum spp.	1		1				2
Vicia	14		1				15
Viola spp.	2			1			3
	1580	463	87	57	55	39	2281
percentages	69	20	4	2.5	2.5	2	

The above table of larval foodplants shows their usage by habitat, related to the occurrence of the moths that feed on them. Plants that are commonly eaten by a species in more than one habitat (column one) and are also eaten by a different species exclusively in another habitat will occur in both (or more) columns.

The low values for conifers reflect the small number of conifer feeding macro-lepidoptera that are indigenous to Britain - although they frequently share a substantial part of the limited range of both native and introduced tree species.

Table 1: The Land Statement - as at 19th March 1987
(more recent data is not presented in a way that allows the ready identification of the categories shown, which are meaningful in wildlife habitat terms).

	Hectares
High Forest	19,753
Felled	744
Lowgrade broadleaved	385
Plantation Scrub	50
Retained Scrub	140
Blank	319
Plantable land in hand	10
Agriculture and Holdings	611
Recreation Sites	92
	22,104

Statement of Plantations - as at 31st March 1990

Table 2: Forest Type Distribution

	%
Conifer	85
Conifer/broadleaved mixtures	9
Broadleaves	6

Table 3: Species Distribution

Conifers	%	Broadleaves	%
Scots pine	31	Oak	3
Corsican pine	54	Beech	4
Larches	1	Birch	1
Douglas Fir	2	Poplar	1
Other conifers	2	Other broadleaves	1
	90		10

Table 4: Age Class Distribution

Age in years	Conifer %	Broadleaved %
1 - 5	10	1
6 - 10	11	1
11 - 20	13	1
21 - 55	41	64
56 - 85	25	26
85+ (pre 1900)		7

Table 5: Forest Habitat Type

Age Years	%	Habitat Phase
Clearfelled	3	Bare to early establishment
1 - 5	8	
6 - 10	9	Late establishment to canopy closure
11 - 20	12	Thicket
21 - 55	42	Plantations in thinning
56 - 85	25	Past normal felling age
85+ (pre 1900)	1	

Table 6:

Habitat	No. of species	% of total species
More than One Habitat	250	50
Broadleaved Forest	108	22
Calcareous Heath	48	10
Acid Heath	25	5
Wetland	47	10
Conifer Forest	13	3

(see appendix 2 for full species list for each habitat type)

Table 7:

Summary of Red Data Book, and NCC Notable, Species of Breckland

Status	Resident before Afforestation	(of which wetland)	New Arrivals	(of which wetland)
RDB 1 (now extinct)	2			
RDB 2 (1 now endangered)	2	(1)		
RDB 3	5	(2)	1	

Status	Resident before Afforestation	(of which wetland)	New Arrivals	(of which wetland)
Na	12	(8)	4	(1)
Nb	26	(6)	4	
	47	(17)	9	(1)

RDB 1 = Endangered; RDB 2 = Vulnerable; RDB 3 = Rare;
Na(Notable a) = recorded nationally from 30 or less 10km squares;
Nb(Notable b) = recorded nationally from 100 or less 10km squares

(see appendix 1 for full species list)
This table does not include those species lost locally which have also suffered larger scale withdrawal from East Anglia, such as fritillary butterflies, nor those newcomers that have spread across Britain.

THE INVERTEBRATE FAUNA OF THE LOWER REACHES OF THE RIVER YARE

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Introduction

In 1976 the Nature Conservancy Council (NCC) commissioned a biological survey of the tidal reaches of the River Bure and River Yare and some of the broads associated with the River Yare. One of the authors (R.J. Driscoll) carried out the study which consisted of two parts: a survey of the contemporary distribution of the aquatic fauna and flora, carried out between December 1976 and March 1977, and a review of published and unpublished records. The results of the survey were included in three unpublished reports (Driscoll, 1980, 1982, 1992a).

Driscoll resurveyed the River Bure and River Yare in March and April 1982 to monitor any changes in the aquatic fauna and flora that had taken place since 1977 (Driscoll, 1985).

Z.L. Slater (Waterford) surveyed the aquatic invertebrate fauna of piled stretches of the River Yare in February 1990 as part of an undergraduate project at the University of East Anglia (Slater, 1990).

This paper summarizes the invertebrate records from the River Yare collected during these three surveys along with other, mainly older, records from other sources. The original unpublished reports should be consulted for more information.

Methods (1976/7, 1982 and 1990 surveys)

The 1976/7, 1982 and 1990 surveys used the same basic sampling technique.

Sampling was carried out from an inflatable dinghy or from the river bank and a hand net was used to scrape any piling present and catch any invertebrates disturbed or detached by the scraping. In 1976/7 and 1982 the same net was used to sweep through any marginal vegetation present or scrape the margin if no vegetation was present. The hand net was used in 1976/7 as a crude trawl to sample the open water.

During the 1976/7 survey 23 sites were sampled along the River Yare between Surlingham Ferry and Berney Arms Windmill (see Table 1 and Figure 1). At each site samples were collected from both margins of the river and from the open water.

The same 23 sites were resampled in 1982. However, only the margins were sampled as experience in 1976/7 had shown that trawling with the equipment available was not worth the effort (see below).

The 1990 survey was concerned only with invertebrates associated with piling. Piling was present at 18 of the sites that had been included in the 1976/7 and 1982 surveys and sampling was restricted to these sites.

Driscoll (1980, 1985) and Slater (1990) include full details of the sample sites and sampling techniques used.

Habitats

Four habitats were recognised and sampled during the 1976/7 survey:

Piling	made of steel (mostly) or wood
Reedswamp	mainly *Phragmites australis* (Cav.) Trin. ex Steudel, but with *Glyceria maxima* (Hartm.) Holmberg, *Carex* spp. etc. present
Eroded margin	vertical or steeply sloping mud where the rond was being eroded
Open water	

As trawling at 23 sample sites produced only a single record of *Potamopyrgus jenkinsi* Smith, which had become detached and was being carried along by the current, no attempt was made to sample the open water in subsequent years.

Other sources of records

When the NCC study started in 1976 it was known that little systematic work on the fauna of the River Yare had been carried out since R. Gurney's pioneering studies in the early part of the twentieth century. Although with the resources available a comprehensive review of the literature to trace biological records from the river was impossible, the *Transactions of the Norfolk and Norwich Naturalists' Society* was thoroughly searched and a number of other references traced.

The NCC files and the collections in the Natural History Museum, London and in the Natural History Department, Castle Museum, Norwich were searched without success. The Anglian Water Authority (AWA) provided records from their biological monitoring programme for the period 1976-1977. Driscoll (1982) includes details of the sources of all of the biological records traced during the desk study. A few records of crustaceans collected from two sites in 1989 and the results of a 1992 survey of barnacles have been included in this paper.

Results

Changes in the invertebrate fauna

The review of published and unpublished records that formed part of the 1976/7 study used two date classes: pre 1961 (older records) and 1961-1977 (excluding records from the NCC survey). The desk study produced records of 51 aquatic invertebrate taxa from the River Yare. There were records of 32 taxa for the period up to and including 1945, and of 22 taxa for the period 1976-1977, with no records for the intervening years.

Most of the older records were of ectoprocts (5 species), gastropods (9 species) and crustaceans (14 species), with a single insect record. The 1976-1977 (AWA) records included no records of ectoprocts, a single species of gastropod and a few records of crustaceans (6 taxa) and insects (4 taxa).

A total of 34 invertebrate taxa was recorded during the 1976/7 NCC survey, consisting mainly of crustaceans (13 taxa) and insects (14 taxa). In 1982 33 taxa were recorded, again mainly crustaceans (15 taxa) and insects (9 taxa). Of these 33 taxa, 21 had been recorded in 1976/7.

Casual collecting in 1989 produced records of 5 species of crustacean, two of which had not been recorded in 1976/7 or 1982.

The 1990 survey produced records of 30 taxa, mainly crustaceans (10 Taxa) and insects (10 taxa), of which 22 had been recorded between 1976/7 and 1989.

Table 2 lists the invertebrate species and other taxa that have been recorded from the River Yare between Surlingham Ferry and Berney Arms Windmill.

Invertebrate faunas of different habitats

In both 1976/7 and 1982 the number of invertebrate taxa recorded from piling was higher than the number recorded from reedswamp or eroded margin. Several taxa were only found on piling, eg. barnacles. The piling communities have been described elsewhere (Driscoll, 1992b). Figure 2 shows the extent of piling along the River Yare in 1990.

Salinity and its effect on the invertebrate fauna

The River Yare is tidal as far upstream as Norwich. The physical effect of the tides (the rise and fall) extends further upstream than the chemical effect (the salinity changes). Salinity at Berney Arms varies according to the state of the tide, but is generally high. The tidal effect decreases upstream and at Surlingham Ferry the river is essentially fresh, although abnormal tides can temporarily raise the salinity.

The invertebrate fauna of the river consisted of freshwater species, brackish-water species, and species that can tolerate a wide range of salinities. The salinity gradient along the river was reflected in the distributions of these species.

The river fauna from Surlingham Ferry downstream as far as Buckenham was relatively species-rich. It consisted mainly of molluscs and insects and included species that require fresh or nearly fresh water such as: *Ephydatia fluviatilis* (L.), *Acroloxus lacustris* (L.), *Bithynia tentaculata* (L.), *Lymnaea peregra* (Müller), *Physa fontinalis* (L.), *Valvata cristata* Müller, *Valvata piscinalis* (Müller), *Asellus aquaticus* (L.), *Leptophlebia vespertina* (L.), *Polycentropus flavomaculatus* (Pictet) and *Potamonectes depressus* ssp. *elegans* (Panzer).

The brackish-water fauna downstream from Reedham consisted mainly of

crustaceans and contained fewer species including: *Electra crustulenta* (Pallas), *Balanus improvisus* Darwin, *Elminius modestus* Darwin, *Semibalanus balanoides* (L.), *Neomysis integer* (Leach), *Leptocheirus pilosus* Zaddach, *Cyathura carinata* (Kröyer), *Ligia oceanica* (L.), *Paragnathia formica* (Hesse), *Sphaeroma rugicauda* Leach and *Palaemonetes varians* (Leach).

The distributions of many species were not so clearly related to salinity and a few species were widely distributed along the river, eg. *Gammarus zaddachi* Sexton.

Figure 3 shows the distributions of three species, based on records from 1977, 1982 and 1990.

Notes on individual taxa recorded by the authors, 1976-1990

Phylum **Porifera**

Ephydatia fluviatilis (L.)

Recorded only on piling, at a few sites between Brundall and Buckenham in 1977 and at Surlingham Ferry in 1982.

Phylum **Coelenterata**

Cordylophora lacustris Allman

Recorded only on piling, at a few sites between Strumpshaw and Seven Mile House in 1977, at a few sites between Six Mile House and Berney Arms in 1982 and near Six Mile House in 1990.

Phylum **Ectoprocta** (Bryozoa)

Electra crustulenta (Pallas)

Recorded on piling near Six Mile House and Berney Arms in 1977.

Unidentified material

Recorded on piling near Berney Arms in 1990.

Class **Gastropoda**

Acroloxus lacustris (L.)

Recorded on piling at Brundall in 1990.

Bithynia tentaculata (L.)

Single specimens were found on piling near Buckenham in 1977, swept from reeds near Hassingham in 1982 and taken from piling at Brundall in 1990.

Lymnaea peregra (Müller)

Recorded on piling at Surlingham Ferry in 1990.

Physa fontinalis (L.)

A few specimens were recorded on piling and from reeds near Buckenham in 1982.

Potamopyrgus jenkinsi (Smith)

Recorded at several sites between Buckenham and the mouth of the River Chet in 1977, at a few sites between Buckenham and Hardley in 1982 and on piling at Brundall and near Limpenhoe in 1990.

Valvata cristata Müller

A few specimens were recorded on piling near Buckenham in 1982.

Valvata piscinalis (Müller)

Recorded only on piling, a few specimens were found near Buckenham in

1982 and at Brundall in 1990.

Class **Bivalvia**

Pisidium sp.

Recorded on piling near Buckenham in 1990.

Sphaerium corneum (L.)

Recorded on piling at Brundall in 1990.

Class **Oligochaeta**

Family Lumbricidae (Unidentified)

Recorded on piling at Brundall in 1990.

Family Naididae (Unidentified)

Recorded only on piling, widely distributed between Buckenham and Berney Arms in 1977 and between Surlingham Ferry and the mouth of the River Chet in 1982.

Family Tubificidae (Unidentified)

Recorded at Cantley and near Upper Seven Mile House in 1977.

Order **Acari** (Unidentified)

A water mite was taken from piling at Surlingham Ferry in 1982.

Order **Cladocera** (Unidentified)

Recorded from piling at a few sites between Surlingham Ferry and Buckenham in 1990.

Subclass **Copepoda** (Unidentified)

Recorded only from piling, a few specimens were taken at Buckenham in 1977. Recorded at a few sites between Surlingham Ferry and Hardley in 1982 and at Surlingham Ferry in 1990.

Subclass **Ostracoda** (unidentified)

Recorded only from piling, a few specimens were taken near Brundall and Langley in 1982 and near Brundall and Buckenham in 1990.

Subclass **Cirripedia**

Balanus improvisus Darwin

Frequent on piling at a few sites downstream from Upper Seven Mile House in 1977. Recorded on all of the piling sampled downstream from Seven Mile House in 1982 and downstream from Upper Seven Mile House in 1990.

Elminius modestus Darwin

This Australasian species was not recorded in Britain until 1945 (Rainbow, 1984) and so was not found by earlier workers. Unfortunately, virtually no work was carried out on the fauna of the lower reaches of the Broadland rivers between 1945 and 1976, when the NCC survey started. This lack of data means that it is impossible to say when *E. modestus* colonised the River Yare.

Recorded on all of the piling sampled downstream from Seven Mile House in 1977, often abundant. Recorded at the same sites in 1982 and on piling near

Berney Arms in 1990.

On 23 April 1992 all of the piling between Reedham and Berney Arms was sampled for barnacles. Although *E. modestus* was found on all of the piling downstream from Seven Mile House *B. improvisus* was not recorded. It is possible that below average rainfall in recent years, by reducing the flow in the river and allowing saline water to penetrate further upstream, has resulted in conditions that favour *E. modestus* rather than *B. improvisus.*

Semibalanus balanoides (L.)

Rare on piling near Berney Arms in 1977.

Order **Mysidacea**

Neomysis integer (Leach)

Recorded from piling near Berney Arms in 1977, caught near Six Mile House in 1982 and recorded from piling at Seven Mile House in 1989.

Order **Amphipoda**

Corophium lacustre Vanhöffen

Recorded only on piling, at a few sites between Buckenham and Six Mile House in 1977 and at a few sites between the mouth of the River Chet and Berney Arms in 1982.

Corophium multisetosum Stock

Recorded at several sites between Brundall and Reedham in 1977, mostly on piling, at several sites between Limpenhoe and Berney Arms in 1982 and on piling at a few sites between Buckenham and the mouth of the River Chet in 1990.

Crangonyx pseudogracilis Bousfield

This North American species was first recorded from Britain in the 1930s (Macan, 1974) and is now widely distributed in Norfolk. In Broadland it was first found in Barton Broad in 1952 (Ellis, 1965) and is now common in marshland dykes. Lack of data means that it is impossible to say when it colonised the River Yare.

Recorded only from piling, a few specimens were recorded near Langley in 1977 and at Surlingham Ferry in 1982.

Gammarus duebeni Lilljeborg

A few specimens were caught near Reedham and Berney Arms in 1977 and recorded from piling near Hardley in 1982.

Gammarus zaddachi Sexton

Widely distributed between Langley and Berney Arms in 1977 and between Buckenham and Berney Arms in 1982, mostly on piling. Widely distributed on piling between Buckenham and Berney Arms in 1990.

Leptocheirus pilosus Zaddach

Recorded only from piling, at two sites between Six Mile House and Berney Arms in 1982, at Seven Mile House in 1989 and near Limpenhoe and at Reedham in 1990.

Order **Isopoda**

Asellus aquaticus (L.)

Recorded only on piling, a few specimens were found at Surlingham Ferry and near Buckenham in 1982 and at Surlingham Ferry in 1990.

Cyathura carinata (Kröyer)

A single specimen was recorded on piling near Berney Arms in 1982.

Ligia oceanica (L.)

Abundant just above water level on a wooden post near the river bank at Seven Mile House in 1989.

Paragnathia formica (Hesse)

Two specimens were recorded on piling at Reedham in 1989.

Sphaeroma rugicauda Leach

A few specimens were swept from reeds near Reedham in 1977 and 1982 and recorded on piling at Seven Mile House in 1989.

Order **Tanaidacea**

Heterotanais oerstedi (Kroyer)

In 1903 R. Gurney recorded a tanaid from the River Yare at Reedham that he could not identify (Gurney 1904). It was later described as a new species *Heterotanais gurneyi* by Norman (1906). The females of *H. oerstedi* and *H. gurneyi* were indistinguishable whereas the males differed in the shape of their chelipeds. It is now known that there is a single species, *H. oerstedi*, that has a very complex life history involving two forms of male (Holdich & Jones 1983).

Recorded on all of the piling sampled between Hardley and Seven Mile House in 1977, usually in large numbers. A few specimens were recorded on piling near Six Mile House in 1982 and on piling near Berney Arms in 1990. Only females were collected in 1977, 1982 and 1990.

Order **Decapoda**

Palaemonetes varians (Leach)

A single specimen was caught in a cavity behind piling near Berney Arms in 1976.

Order **Ephemeroptera**

Centroptilum luteolum (Müller)

A single larva was caught on piling near Upper Seven Mile House in 1977.

Cloeon dipterum (L.)

Larvae were recorded at the majority of sites between Brundall and Cantley in 1977, mostly on piling, and on piling at Surlingham Ferry and Brundall in 1990.

Leptophlebia vespertina (L.)

Two larvae were recorded on piling at Brundall in 1990.

Order **Hemiptera**

Callicorixa praeusta (Fieber)

Recorded at several sites between Brundall and Reedham in 1977. A few specimens were recorded from piling at Brundall in 1982 and more were recorded from piling at a few sites between Brundall and Seven Mile House in 1990.

Cymatia bonsdorffi (C. Sahlberg)

A single specimen was recorded from reeds near Buckenham in 1982.

Cymatia coleoptrata (Fabricius)

Recorded at a few sites between Surlingham Ferry and Cantley in 1977.

Hesperocorixa linnei (Fieber)

A few specimens were recorded from piling near Langley in 1977 and from piling at Brundall in 1982.

Notonecta viridis Delcourt

A single specimen was recorded from piling near Seven Mile House in 1977.

Sigara concinna (Fieber)

Recorded at a few sites between Hassingham and Berney Arms in 1976 and 1977 and from piling near Reedham in 1990.

Sigara distincta (Fieber)

Recorded from piling near Buckenham and Hardley in 1977.

Sigara dorsalis (Leach)

Recorded at several sites between Langley and Seven Mile House in 1977, from piling near Brundall in 1982 and from piling at a few sites between Brundall and Limpenhoe in 1990.

Sigara falleni (Fieber)

Recorded at a few sites between Strumpshaw and Reedham in 1977 and from piling at Brundall and near Buckenham in 1990.

Sigara fossarum (Leach)

Recorded from piling near Buckenham in 1977.

Sigara nigrolineata (Fieber)

A few specimens were swept from reeds near Hassingham and the mouth of the River Chet in 1982.

Order **Trichoptera**

Polycentropus flavomaculatus (Pictet)

Three larvae were found on piling at Surlingham Ferry in 1990.

Order **Diptera**

Family Chironomidae (Unidentified)

Larvae were recorded at numerous sites between Brundall and Berney Arms in 1977, mostly on piling, at numerous sites between Surlingham Ferry and Berney Arms in 1982 and on piling at a few sites between Surlingham Ferry and Langley in 1990.

Order **Coleoptera**

Gyrinus marinus Gyllenhal

Single specimens were caught near Hassingham in 1982 and taken from piling near Hardley in 1990.

Haliplus sp. (*ruficollis* group females)

A few specimens were taken from piling near Langley in 1977 and at Brundall and near Hassingham in 1982.

Hydroporus palustris (L.)

Small numbers were recorded at a few sites between Cantley and Reedham in 1977.

Potamonectes assimilis (Paykull)

A single specimen was taken from piling near Langley in 1982.

Potamonectes depressus ssp. *elegans* (Panzer)

Recorded from piling at Surlingham Ferry and near Buckenham in 1990.

Taxa recorded from the River Yare but not seen by the authors, 1976-1990

Several taxa that have been recorded from the River Yare were not found during the recent surveys. In some cases the lack of recent records may simply be due to uncommon species being overlooked. It is possible that some of the original records were misidentifications and some were of species that would not normally live in the river. The disappearence of other species is almost certainly due to changes in water quality that have taken place during the twentieth century.

Phylum **Protozoa**

Carchesium sp.
Zoothamnium geniculata

Protozoans are a group that is overlooked by most workers.

Class **Rotifera**

Floscularia ringens (L.)
Unidentified material

Rotifers are another group that is easily overlooked.

Phylum **Ectoprocta**

Cristatella mucedo Cuvier
Fredericella sultana (Blumenbach)
Lophopus crystallinus (Pallas)
Paludicella articulata (Ehrenberg)
Plumatella repens (L.)

Earlier this century the River Yare near Brundall and some of the nearby broads were good localities for ectoprocts. The lack of recent records, despite careful searching, is almost certainly the result of a deterioration in water quality.

Class **Gastropoda**

Assiminea grayana Fleming
Bithynia leachii (Sheppard)
Gyraulus albus (Müller)
Hydrobia ventrosa agg.
Lymnaea auricularia (L.)
Pseudamnicola confusa (Frauenfeld)
Theodoxus fluviatilis (L.)
Viviparus contectus (Millet)
Viviparus viviparus (L.)

The River Yare used to support many more species of gastropod than were found during the recent surveys. The losses are thought to be due to a decline in water quality and dead shells of species that were no longer present as live animals were found at several sites during the surveys.

Class **Bivalvia**

Unio pictorum (L.)

Dead shells were found during the recent surveys.

Class **Oligochaeta**
Family Lumbriculidae (Unidentified)

Class **Hirudinea**
Theromyzon tessulatum (Müller)

Subclass **Copepoda**
Dactylopusia tisboides (Claus)
Tachidius brevicornis Lilljeborg
Tachidius incisipes Klie
Thersitina gasterostei Pagenstecher

R. Gurney was an expert on copepods and recorded many species from the Broadland rivers. Recent workers have not identified the copepods they have collected.

Order **Mysidacea**
Mesopodopsis slabberi (van Beneden)

The only recent records of mysids are of *N. integer.*

Order **Amphipoda**
Gammarus locusta (L.)
Orchestia cavimana Heller
Orchestia gammarellus (Pallas)

It is possible that Gurney's 1903 record of *G. locusta* was based on a misidentification.

Order **Isopoda**
Jaera albifrons agg.

Although there are no recent records of this taxon from the River Yare it was recorded from a dyke draining marshland next to Breydon Water in 1974 (Driscoll, unpublished record).

Order **Hemiptera**
Corixa panzeri (Fieber)

Although there are no recent records of this species from the River Yare it was recorded from several dykes draining marshland adjacent to the river in 1974 (Driscoll, 1976).

Order **Trichoptera**

Family Limnephilidae (Unidentified)

Order **Coleoptera**
Hygrobia herrmanni (Fabricius)

This species is unlikely to have been resident in the river and the single record is of little significance.

Discussion

Some of the species found in the River Yare by Gurney and other workers were also recorded during the surveys described above. Many species were not recorded (mainly ectoprocts and gastropods) and the lack of recent records was due to the disappearence of these species, almost certainly as a result of the long term deterioration in water quality in the river.

The recent surveys found several 'new' species. In some cases these were relatively recent additions to the fauna, eg. *E. modestus*. In other cases they were species that had probably been overlooked by earlier workers, eg. *P. formica*.

Piling was found to be an important habitat for many species. The piling of long stretches of riverbank this century has not only created more of this habitat, it may have extended the range of some species.

As expected in a tidal stretch of river, salinity was found to be an important factor in determining the species richness and composition of the the aquatic invertebrate community. Compared with marine and freshwater habitats the brackish-water tidal parts of rivers support a limited range of species as relatively few taxa can tolerate the fluctuating conditions. This was apparent in the recent survey results (no sample site yielded more than 13 taxa).

During the 1980s the AWA carried out surveys of the river downstream as far as Reedham using trawls and colonization samplers. In general the AWA surveys recorded a greater range of species at each sample site, emphasizing the influence that sampling technique can have on results (George, 1992).

Acknowledgements

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References

Copies of the unpublished reports are held by English Nature, 60 Bracondale, Norwich and the Natural History Department, Castle Museum, Norwich.

DRISCOLL, R.J. 1980 *Distribution maps of aquatic vertebrates and invertebrates and aquatic plants recorded from the Rivers Bure and Yare and from Strumpshaw, Surlingham, Rockland and Wheatfen Broads, 1976-1977.* Unpublished report prepared for Nature Conservancy Council.

DRISCOLL, R.J. 1982 *The Aquatic vertebrate and invertebrate fauna and aquatic flora of the lower reaches of the Rivers Bure and Yare, Breydon Water, and Strumpshaw, Surlingham, Rockland and Wheatfen Broads.* Unpublished report prepared for Nature Conservancy Council.

DRISCOLL, R.J. 1985 *Distribution maps of aquatic invertebrates and aquatic plants recorded from the Rivers Bure and Yare, 1982.* Unpublished report.

DRISCOLL, R.J. 1992a *The aquatic fauna and flora of the lower reaches of the Rivers Bure and Yare, Breydon Water, and Strumpshaw, Surlingham, Rockland and Wheatfen Broads.* Unpublished report prepared for English Nature.

DRISCOLL, R.J. 1992b Macroinvertebrates on piling along the lower reaches of the River Yare and River Bure: an overlooked community on an undervalued habitat. *Transactions of the Norfolk and Norwich Naturalists' Society* **29**(3), 233-236.

ELLIS, E.A. 1965 *The Broads*. London: Collins.

GEORGE, M. 1992 *The land use, ecology and conservation of Broadland.* Chichester: Packard.

GURNEY, R. 1904 The fresh- and brackish-water Crustacea of east Norfolk. *Transactions of the Norfolk and Norwich Naturalists' Society* 7(5), 637-661.

HOLDICH, D.M. & JONES, J.A. 1983 *Tanaids. Keys and notes for the identification of the species.* Cambridge: Cambridge University Press. (Synopses of the British Fauna (New series) No. 27).
MACAN, T.T. 1974 Freshwater invertebrates. *In*: Hawksworth, D. L. (ed.) *The changing flora and fauna of Britain.* London: Academic Press.
NORMAN, A.M. 1906 A new *Heterotanais* and a new *Eurydice*, genera of Isopoda. *Annals and Magazine of Natural History* ser.7 **17**(97), 167-171.
RAINBOW, P.S. 1984 An introduction to the biology of British littoral barnacles. *Field Studies* **6**(1), 1-51.
SLATER, Z.L. 1990 *The aquatic macro-invertebrate fauna on piling along the lower reaches of the River Yare.* Unpublished undergraduate project, University of East Anglia.

Table 1.

Sample sites studied by the authors along the lower reaches of the River Yare, 1976 - 1990.

Site No.	Locality	Grid Ref.	Distance from mouth of R. Yare (Km.)	Habitats present in 1977[1]	Date[2]
Y 12	Surlingham Ferry	TG 307075	37.9	P E	A B D
Y 11	Near Brundall	TG 314080	36.9	P E	A B D
Y 10	Brundall	TG 324071	34.4	P	A B D
Y 9	Near Strumpshaw Dike	TG 335061	32.9	E	A B
Y 8	Near Strumpshaw	TG 342051	31.4	P R[3]	A B
Y 7	Near Buckenham	TG 348049	30.7	P	A B D
Y 13	Near Beauchamp Arms Inn	TG 351044	30.0	P R	A B D
Y 14	Near Hassingham	TG 362044	28.8	R E[4]	A B
Y 15	Near Langley	TG 363038	28.1	P R	A B D
Y 16	Near Langley Dike	TG 369029	27.0	P E	A B D
Y 17	Near Cantley	TG 376029	26.2	R E	A B
Y 18	Cantley	TG 385033	25.1	P R	A B D
Y 19	Near Hardley	TG 387022	23.8	P E	A B D
Y 20	Near Limpenhoe	TG 393016	22.8	P R	A B D
Y 21	Near mouth of River Chet	TG 400012	21.4	P R	A B D
Y 22	Near Reedham (upstream)	TG 410016	20.1	P R	A B D
Y 2	Reedham Quay	TG 420016	18.9	P R	A B C D
Y 3	Near Reedham (downstream)	TG 430016	17.8	R	A B
Y 4	Near Upper Seven Mile House	TG 441027	15.9	P E	A B D

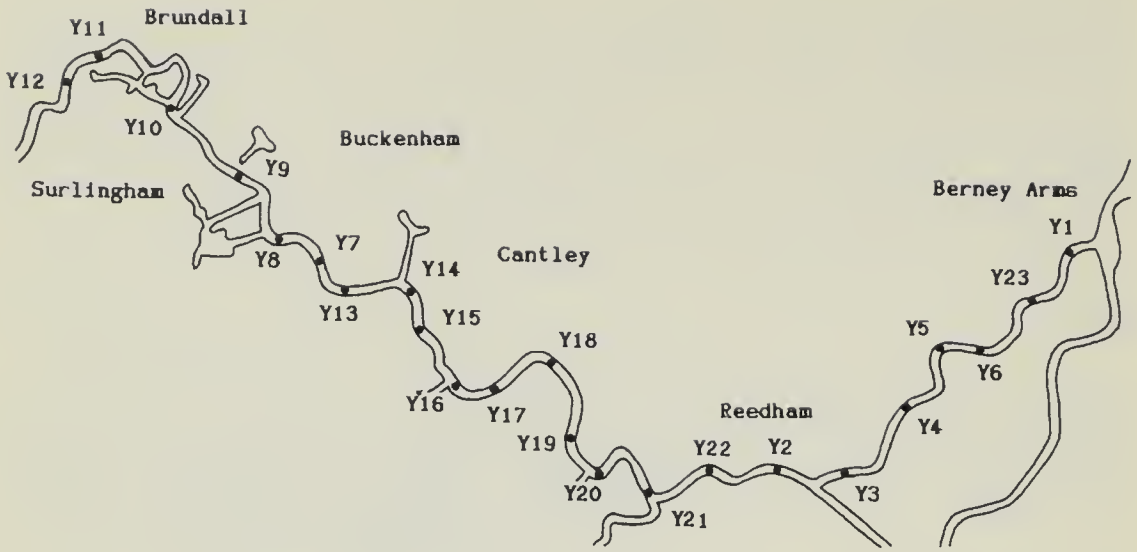


Fig. 1. Map of the lower reaches of the River Yare showing the sample sites studied by the authors, 1976-1990.

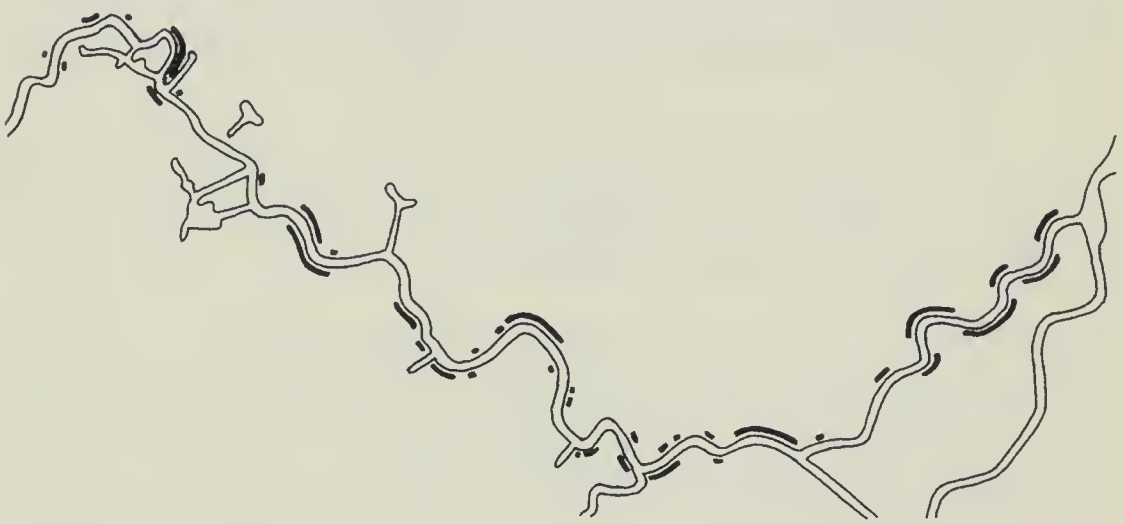
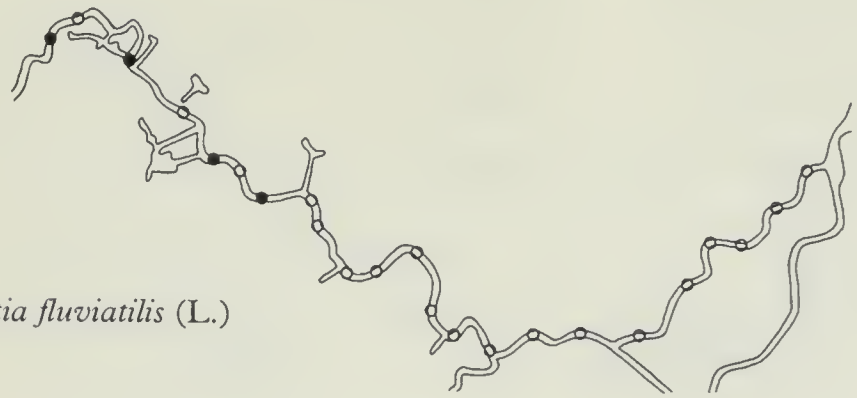
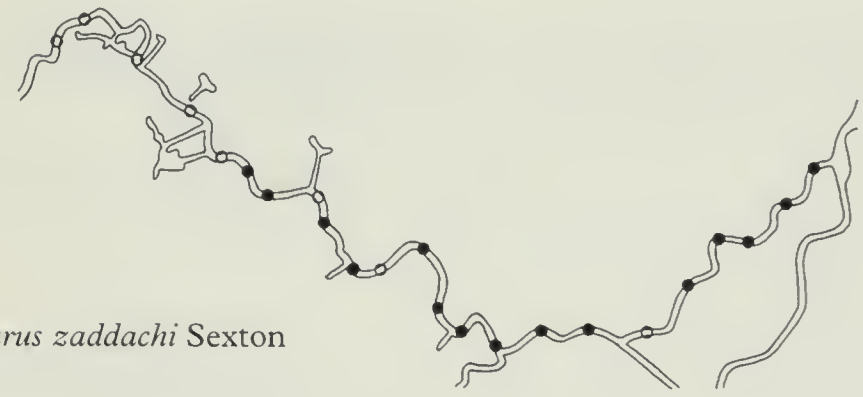


Fig. 2. Map of the lower reaches of the River Yare showing the extent of piling in 1990.

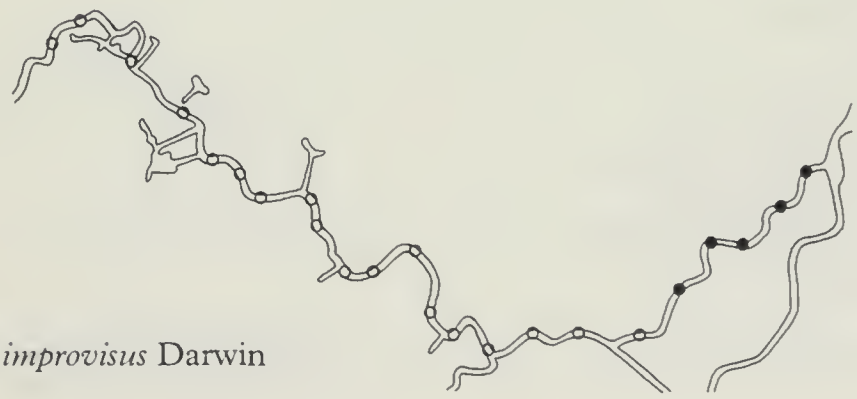
Fig. 3. Maps showing the distribution of three species of aquatic invertebrate recorded from the lower reaches of the River Yare, 1976-1990.



Ephydatia fluviatilis (L.)



Gammarus zaddachi Sexton



Balanus improvisus Darwin

Site No.	Locality	Grid Ref.	Distance from mouth of R. Yare (Km.)	Habitats present in 1977[1]	Date[2]
Y 5	Near Seven Mile House	TG 446035	14.7	P E	A B C D
Y 6	Near Six Mile House	TG 452034	14.0	P E	A B D
Y 23	Near Langley Marshes	TG 459042	12.6	P E	A B D
Y 1	Near Berney Arms Windmill	TG 465050	11.4	P E	A B D

[1] P Piling
R Reedswamp
E Eroded margin

[2] A 1976/7 Nature Conservancy Council survey
B 1982 R. J. Driscoll survey
C 1989 R. J. Driscoll records
D 1990 Z. L. Slater survey

[3] R E in 1982 (wooden piling present in 1977 had disappeared by 1982)

[4] R in 1982 (there had been some recovery of the reedswamp since 1977)

Table 2.

Aquatic invertebrates recorded from the River Yare between Surlingham Ferry and Berney Arms, up to 1990 (habitat indicated where known[1]).

Taxa	Date[2]					
	-1961	1961-77	1976/7	1982	1989	1990
Phylum Protozoa						
Carchesium sp.		?				
Zoothamnium geniculata	?					
Phylum Porifera						
Ephydatia fluviatilis (L.)		?	P	P		
Phylum Coelenterata						
Cordylophora lacustris Allman			P	P		P
Class Rotifera						
Floscularia ringens (L.)	?					
Unidentified		?				
Phylum Ectoprocta						
Cristatella mucedo Cuvier	?					
Electra crustulenta (Pallas)			P			
Fredericella sultana (Blumenbach)	?					
Lophopus crystallinus (Pallas)	?					
Paludicella articulata (Ehrenberg)	?					
Plumatella repens (L.)	?					
Unidentified						P
Class Gastropoda						

Taxa	Date[2]					
	-1961	1961-77	1976/7	1982	1989	1990
Acroloxus lacustris (L.)	?					P
Assiminea grayana Fleming	?					
Bithynia tentaculata (L.)			P	R		P
Gyraulus albus (Müller)	?					
Hydrobia ventrosa agg.	?					
Lymnaea auricularia (L.)	?					
Lymnaea peregra (Müller)						P
Physa fontinalis (L.)				PR		
Potamopyrgus jenkinsi (Smith)		?	PRO	PR		P
Pseudamnicola confusa (Frauenfeld)	?					
Theodoxus fluviatilis (L.)	?					
Valvata cristata Müller				P		
Valvata piscinalis (Müller)				P		P
Viviparus contectus (Millet)	?					
Viviparus viviparus (L.)	?					
Class Bivalvia						
Pisidium sp.						P
Sphaerium corneum (L.)		(?)[3]				P
Unio pictorum (L.)	?					
Class Oligochaeta						
Family Lumbricidae (Unidentified)		?				P
Family Lumbriculidae (Unidentified)		?				
Family Naididae (Unidentified)		?	P	P		
Family Tubificidae (Unidentified)		?	PR			
Class Hirudinea						
Theromyzon tessulatum (Müller)		?				
Order Acari (Unidentified)		?		P		
Order Cladocera		?				P
Subclass Copepoda	?					
Dactylopusia tisboides (Claus)	?					
Tachidius brevicornis Lilljeborg	?					
Tachidius incisipes Klie	?					
Thersitina gasterostei Pagenstecher	?					
Unidentified		?	P	P		P
Subclass Ostracoda		?		P		P
Subclass Cirripedia						
Balanus improvisus Darwin	?		P	P		P
Elminius modestus Darwin			P	P		P
Semibalanus balanoides (L.)			P			
Order Mysidacea						
Mesopodopsis slabberi (van Beneden)	?					
Neomysis integer (Leach)			P	E	P	
Order Amphipoda						
Corophium lacustre Vanhöffen		(?)[3]	P	P		
Corophium multisetosum Stock			PRE	PE		P
Crangonyx pseudogracilis Bousfield			P	P		

Taxa	Date[2]					
	-1961	1961-77	1976/7	1982	1989	1990
Gammarus duebeni Lilljeborg			PR	P		
Gammarus locusta (L.)	?					
Gammarus zaddachi Sexton		?	PE	PE		P
Leptocheirus pilosus Zaddach				P	P	P
Orchestia cavimana Heller	?					
Orchestia gammarellus (Pallas)	?					
Order Isopoda						
Asellus aquaticus (L.)				P		P
Cyathura carinata (Kröyer)				P		
Jaera albifrons agg.	?					
Ligia oceanica (L.)	?				P	
Paragnathia formica (Hesse)					P	
Sphaeroma rugicauda Leach	?		R	R	P	
Order Tanaidacea						
Heterotanais oerstedi (Kröyer)	?		P	P		P
Order Decapoda						
Palaemonetes varians (Leach)	?	?	P			
Order Ephemeroptera						
Centroptilum luteolum (Müller)			P			
Cloeon dipterum (L.)		?	PRE			P
Leptophlebia vespertina (L.)						P
Order Hemiptera						
Callicorixa praeusta (Fieber)			PRE	P		P
Corixa panzeri (Fieber)	?					
Cymatia bonsdorffi (C. Sahlberg)				R		
Cymatia coleoptrata (Fabricius)			PR			
Hesperocorixa linnei (Fieber)			P	P		
Notonecta viridis Delcourt			P			
Sigara concinna (Fieber)			RE			P
Sigara distincta (Fieber)			P			
Sigara dorsalis (Leach)			PR	P		P
Sigara falleni (Fieber)			PE			P
Sigara fossarum (Leach)			P			
Sigara nigrolineata (Fieber)				R		
Order Trichoptera						
Family Limnephilidae (Unidentified)		?				
Polycentropus flavomaculatus (Pictet)						P
Order Diptera						
Family Chironomidae (Unidentified)		?	PRE	P		P
Order Coleoptera						
Gyrinus marinus Gyllenhal				R		P
Haliplus sp. (*ruficollis* group females)			P	PR		
Hydroporus palustris (L.)			PRE			
Hygrobia herrmanni (Fabricius)		?				
Potamonectes assimilis (Paykull)				P		
Potamonectes depressus ssp. *elegans* (Panzer)						P

Number of taxa recorded	32	22	34	33	5	30
Total number of taxa	87					

[1] P Piling
R Reedswamp
E Eroded margin
O Open water
? Habitat not recorded

[2] -1961 Pre 1961, various sources
1961-77 Anglian Water Authority records, 1976-1977
1976/7 Nature Conservancy Council survey, 1976-1977
1982 R. J. Driscoll survey, 1982
1989 R. J. Driscoll records
1990 Z. L. Slater survey, 1990

[3] ( ) Identification uncertain

THE STATUS OF PROLIFEROUS PINK (*PETRORHAGIA PROLIFER*) IN NORFOLK

G. Beckett

Bramley Cottage, Stanhoe, Kings Lynn, Norfolk. PE31 8QF

Introduction

This small and dainty pink has been placed in three different genera at various times: *Dianthus, Kohlrauschia* and now *Petrorhagia*. It is an annual with flowering stems usually 30 - 40 cm. high bearing clusters of tiny, pale pink flowers only one of which is ever out at one time, it is closely related to the Chidling Pink *(Petrorhagia nanteulii)* and is separated from it by a small number of characters of which the most important is the surface of the seeds. Stace (1992) states that it is "possibly native; dry banks; Beds., possibly elsewhere in England"

Status in Norfolk

Trimmer (1866) records it in the 1840s between Stanhoe and Bircham, and at Fincham. Nicholson (1914) adds no new records. Salisbury (1932) considered it as a rare but native species occurring in Norfolk at its northerly limit in Britain. Petch and Swann (1968) considered that it was a casual in Norfolk and give the following two localities: near Northwold in 1927, J.E.Little and Cranwich, by the Devil's Ditch in 1950, E.L.Swann. Other known records this century are Mundford in 1951, Mrs Gomershall and at a second site in Cranwich in 1985, Mrs J.E.Gaffney. It may be significant that these are neighbouring parishes and

that the records therefore represent relict populations of much larger population native to the sandy soil of the area. When not in flower it is a very difficult plant to find which could be the explanation for the scarcity of records. A search of these and neighbouring parishes may reveal other colonies.

Acknowledgements
My thanks to Dr. John Akeroyd for identification and advice.

References
NICHOLSON, W.A. 1914 *A Flora of Norfolk.*
PETCH, C.P. & SWANN, E.L. 1968 *Flora of Norfolk.* Jarrolds.
SALISBURY, E.J. 1932 The East Anglian Flora *Trans. Norfolk Norwich Nat. Soc.* **13** (3) 191-265.
STACE, C. 1992 *New Flora of the British Isles.* Cambridge University Press.
TRIMMER, K. 1866 *Flora of Norfolk.*

NOTES FOR AUTHORS

The Transactions are published each year in the spring. Manuscripts should be with the editor by 1 December of the previous year.

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Patron: Her Majesty the Queen

The County's senior natural history society. It has for its principal objectives the practical study of natural science, the conservation of wild life, the publication of papers on natural history, especially those related to the county of Norfolk, arranging lectures and meetings and the promotion of active fieldwork. Specialist Groups cover most aspects of the county's flora and fauna.

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